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THE COMPOUNDING OF LIGHTING BALANCERS.

The direct-current balancer is a well-known and very useful device for maintaining regulation on a three-wire or multiple-wire system subject to unbalanced loads and supplied by a generator connected only to the outers of the distributing system. A comparatively small balancing machine is capable of regulating or maintaining balance upon such a system. When motors only are operated from the multi-voltage system the balancer is not called upon to be very precise in its work, because so long as the voltage variations between any pair of conductors are not sudden their range may be fairly wide without sensibly disturbing the operation of the system. When, however, incandescent lamps have to be operated from a balancer, the best regulation it can be made to give will not be good enough for the station manager and more care has to be devoted to the degree of automatic regulation supplied by the balancer. In the ordinary simple shunt-balancer, the voltage always falls to some extent on the loaded side, just as it does in the ordinary three-wire Edison system operated by a pair of constant-potential dynamos in series. The cause of this behavior is explained in the article by Mr. Budd Frankenfield on page 1067 of this number.

The article shows that the best way to excite shunt-balancer fields is to connect its coils from opposite sides of the system. Otherwise the better plan is to connect them across the outers. Compound-wound balancers are, however, relied upon for the best work in regulation, and the exact amount of compounding required is not easy to predetermine. In fact, it usually takes a considerable amount of experimental adjustment to determine the best numbers of series turns on a balancer set in order to arrive at the best automatic regulation. One notable simplification in the balancer problem as applied to incandescent lighting is that only three wires and two similar members have to be considered. That is to say, lighting balancers are rarely called upon to give more than two equal voltages, so as to provide a neutral point. The two members, being thus equal and symmetrical, are relatively easy to deal with. In the case of motor control in factories, however, where individual tools must be capable of continuous operation over a wide range of speeds, three voltages of different magnitudes have usually to be provided, thus calling for three members in the balancer set, of different e.m.f's resistance and power. The accurate compounding of such multiple sets is naturally a more complex problem.

CONVERTER SUBSTATIONS.

The rotary converter has become the main reliance of electric railways of the larger sort, and while it is unquestionably a valuable piece of apparatus, it has earned a somewhat unenviable reputation for a certain asperity of disposition, as one may say, that leads the operator to use extreme tact in dealing with it. Mr. Ashe's discussion, in his recent A. I. E. E. paper, of starting conditions impresses one very forcibly with the complexity of the situation from the operative standpoint. Of the three methods noted none is entirely satisfactory and each is considerably used. We are rather disposed to look upon starting from the direct-current side as upon the whole the best. For one thing it permits great exactness in synchronizing, so that when it is necessary to throw in a fresh

converter with the minimum disturbance of voltage the other methods seem rather crude. They are nevertheless much used, even starting the converter as an induction motor being a method by no means uncommon. This was the earliest method employed, and crude though it is, it is simple and certain. Converters, however, are generally so bad as induction motors that the starting currents run very high and the effects on the line voltage are liable to be serious, especially if the converters are used on the same circuit with lights. Purely for railway working, however, this objection ceases to be serious. Any rigid requirement as to uniformity of voltage is likely to encourage the use of motor-generators. But from any point of view a rotary sub-station is a costly and complicated affair. The change from alternating current on the distributing system to direct current on the working conductors is one made at considerable loss, both in energy and in fixed and operating charges, and after it is completed the voltage at which the direct current is furnished is too low for large work save at forbidding expense for conducting material.

This question aside, however, the converter sub-station has been made operatively successful and is the main reliance of many important systems. It is clear from the paper before us that the same questions as to switchboard arise in generating stations and sub-stations. For the past few years a theory of switchboard construction and design has been uppermost which has not been altogether happy in its applications. In effect the advanced switchboard designer has tried to eliminate the human element as far as possible, and for every imaginable contingency has tried to provide a remedy on the board, automatic if possible. The result has been a large amount of highly ingenious switchboard apparatus, costly to install, and requiring considerable care in maintenance. In the design of a modern station the switchboard has become a very large item of expense, rising to a quarter or a third of the cost of the electrical apparatus it is intended to control. And frankly, if one examines such a structure he generally finds that nearly half the cost lies in various refinements that are of somewhat fanciful utility. Even so valuable a thing as the remote-control switch is not infrequently installed where a manual switchboard would do precisely as well at a small fraction of the cost. The mere fact that remote-control switches are provided with return signals to show whether the alleged automatic devices have really worked is inspiring of solemn thought. We believe that at the present time there is beginning to appear a tendency toward reversion to simpler apparatus of control. The mere cost of application is serious, and from an operative standpoint simplicity is the thing. It is very gratifying to have a large assortment of polished and lacquered automatic circuit-breakers, but we have seen too many of them tied up to regard them with proper respect. It is the operator who watches his machines and pulls his load through that makes the system reliable. Automatic apparatus cannot see beyond the actuating forces, while human intelligence can look to the underlying causes and act accordingly. The thinking machine has yet to be invented.

THE PATENT SITUATION.

We print in another column a communication which presents a view of the patent situation from the standpoint of the patent attorney, and which appears to imply that in offering suggestions on patent reform from another standpoint we have been guilty of an impertinence. So far from misunderstanding what patents purport to be, as seems to be insinuated, we know only too well how far what they purport to be swings wide of what they ought to be. The view of the patent system which our correspondent arises to defend is naturally *ex parte,* while our view is that the sole purpose of patents should be to benefit the public and inventor rather than to promote the interests of the legal fraternity. We made the suggestion that "a patent once issued ought to carry with it the highest presumption of full validity and should protect its owner in the right of manufacture." In reality patents do not protect the inventor because they do not grant to him any rights of which he can be assured prior to a long term of costly and wearisome litigation, and they do not protect the public interests for the same excellent reason. To say that the Patent Office proceedings are *ex parte* is a waste of breath, as any one who has watched a really vigorous interference case ought to know. In the present state of things they are *ex parte* merely until the Examiner sees a conflict of rights with another case. The Patent Office actually does exercise judicial functions, and in our view should be authorized and directed to exercise them much more fully than at present, so that as respects not only conflict with cases in the office, but with patents already issued, the rights of the inventor should be defined once for all, save as in rare instances allegations of fraud might be raised. The examiner now cites in his answers to applicant prior patents, and it is our contention that no patent should issue until the relation of the new matter to the old is determined, not by a long drawn litigation conducted years afterwards, but by final action in the Office, by process alien to interference proceedings, in case the applicant preferred pushing his case to taking what he could get. And in our view the result of such a course should be to settle once for all whether a patent as issued is free in its entirety or is directly tributary to fundamental patents and merely an improvement thereon. The Patent Office lacks now the very power that it should have, to guarantee to the inventor who is granted a patent that his rights as therein defined are not to be assailed in virtue of vague and shadowy claims skulking behind the prolix verbiage of the attorney who drew them. If one invents an improvement, let us say in telephony, let him know from the start what he is entitled to and to what patents, if any, he is frankly subsidiary, and subject to this plain declaration hold him safe from attack, unless for fraud.

We are well aware that such a revolution in procedure would reduce the number of patents granted and would increase the cost of getting them, but once obtained they would be of some value, and an intending manufacturer could acquire a patent on its merits without buying a series of lawsuits along with it. Moreover, greater strictness would tend to reduce the number of frivolous and "paper" patents which now clutter the way of improvement. Of course our correspondent may shudder with sympathy for the poor inventor facing the terrors of the Patent Office under the new régime, but we assure him that the poor inventor would be better off thus than when given a cheap patent which he can neither sell nor even pawn on account of threatened infringement suits. Much nonsense and some truth has been written about the heart-rending efforts of the poor inventor struggling against poverty and discouragement to bring to perfection the product of his genius. But these preliminaries are insignificant compared with the terrors which he faces when he gets his patent and tries to do something with it in face of the ensuing storm of litigation. An old *Patent Office Gazette* is the saddest graveyard of wasted money and blasted hopes that can well be imagined. An analysis of the history of its contents, if such a thing were possible, would be the most terrible arraignment of our present patent system that could ever be devised. Under the beautiful procedure that our correspondent so strenuously defends, the

inventor asks a fish, and the Patent Office blithely passes him out a serpent. The inventor is not the sole sufferer, for many a manufacturer has taken up an article in perfectly good faith only to be wrecked by the vicious litigation that has been opened as soon as his business has grown profitable. As our correspondent very justly intimates, our present system is largely due to the efforts of the patent attorneys—it is now time for the inventor and the investor to have a voice.

From a technical standpoint a rigid examination of apparent conflicts in the office has an enormous advantage over a struggle conducted years afterwards. At the present time one of the greatest difficulties in getting at the rights of a patent litigation is that of keeping distinct the difference between the state of the art when the patent was granted and that which has grown up since. In electrical causes particularly the just adjudication of conflicting claims ten years old is sometimes well nigh impossible. At the time the patents were issued their relation could have easily been made clear, but after the art has changed the men who drew the claims cannot remember what they intended them to mean. If conflicts could be decided in the office they could easily be made brief and to the point, however distasteful such a change in procedure might be to those benefitting from conflicts. The government which grants a patent certainly has full rights in determining the conditions of the grant, no one being under any compulsion to apply for a patent unless he believes it to be for his advantage. The patent system has to-day become more through custom than through fundamental principles a hotbed of litigation. The English system, loose as it is, has proved hardly more objectionable in practice. The remedies for litigation proposed by the attorneys are delightfully naïve—more courts, with more room for litigation. Our own belief, looking at the matter from the standpoint of the inventor and manufacturer, is that the Patent Office should be clothed with more power and dignity, its head be made a better paid and more permanent official, its examiners more carefully trained and selected and given a better outlook, and that the procedure of the office should be so changed as to make a patent once issued extremely difficult to assail, perhaps even by statute incontestable after a fixed period like a land title under the registration system. Reform of the patent procedure in the courts is a good thing in its way, as half a loaf is better than no bread; but it is more important to discourage the beginnings of litigation.

An Alternating-Current Rectifier.

Rotating parts are essential in any dynamo-electric machine which converts alternating current into direct current. This is an unfortunate penalty attached to such conversion; and we would gladly possess as simple a stationary apparatus for converting alternating into direct currents as we already possess in the transformer for changing alternating into alternating currents of different pressures. It may be that the general solution of this problem will be furnished by vacuum tube or by other non-magnetic means; but at present we have to be content with revolving parts for all conversion on a large scale. We print on page 1072 this week an article describing a "permutator" of European manufacture, as exhibited recently at the Liege Electrical Exhibition. Allusion has already been made to this machine in our Digest columns of November 11. It appears on examination that the machine is a particular form of converter, and not a rectifier as that term is ordinarily used. In the ordinary type of converter there is an external stator field frame, embracing a rotor armature arranged to revolve about a horizontal shaft. The armature has a single closed winding, which is tapped at intervals and connected both to slip rings and to the segments of a commutator. Stationary brushes lead alternating currents into the winding through the slip rings on one side, while other stationary brushes lead direct currents out of the commutator on the other side. Since relative motion only is required between the stator and the rotary field, the machine is manifestly capable of being made to operate with the armature stationary, and the field magnetism plus direct-current brushes revolving. This is just what the article describes in the permutator, which is the rotor-stator inversion of the ordinary type of converter. The stator armature is the external member, and within it is placed a rotor field magnet, arranged to rotate about a vertical axis. The direct-current brushes are fastened to the rotor field magnet system. The stator armature winding is connected in six-phase to the secondary windings of a three-phase transformer system, and also to a stationary commutator of the ordinary direct-current type. A rotating magnetic field is thus set up in the stator by the six-phase alternating current. By means of the brushes rotating synchronously around the commutator at the proper positions with respect to the rotating magnetic field, the direct currents are carried away, being converted from the alternating currents admitted to the apparatus.

The question arises as to the relative advantages or disadvantages of this type of converter by comparison with the ordinary type, the electromagnetic actions occurring in both being the same. It does not appear that the efficiency or power factor reported of the "permutator" are superior to those of an ordinary converter of the same power. From a mechanical standpoint the brushes and brush-holders of the permutator are harder to design than those of a converter, because centrifugal force in the type described tends to reduce their pressure on the commutator at full speed. If any brush gets out of order in a converter it may readily be replaced. In the permutator a brush cannot be changed or adjusted without stopping the machine. On the other hand, the permutator leads in regard to compactness. The rotor field magnets have about the same weight and size as the commutator. The permutator type may well save in floor space and in size of machine, items which are of considerable importance in city or suburban traction. Of course this compactness introduces difficulties in cooling that may appreciably influence the design. It is claimed that 66.6 watts per kilogramme, or about 30 watts per pound of total machine weight, can be obtained from these permutators, whereas only about 15 watts per pound can be obtained in practice from ordinary converters. A considerable advantage in favor of the permutator type lies in its small radius of gyration and moment of inertia. This should enable the machine to follow changes in frequency without nearly so much danger of dropping out of step as exists in ordinary converters. It is true that the ordinary converter, as at present constructed, is a very satisfactory machine; but if the generating plant gets into trouble and begins to oscillate in frequency, it stands to reason that the lower the moments of inertia of converter rotors connected to the system, the more range of oscillation they will stand without breaking out of synchronism, and also the smaller the correcting currents required to maintain isochronism during the disturbance. The statement that these permutators, in 150-kw sizes, can be synchronized from rest in three seconds of time, bears upon and ilustrates their responsiveness to changes in frequency. Taking all things into consideration, therefore, it would seem as though the permutator type of converter might come into favor.

A New and Higher Standard of Direct-Current Operation.

BY FRANK J. SPRAGUE.

THE hope of extended electric equipment and operation on the main lines of trunk railways, as distinguished from special problems such as terminals, tunnels and congested sections, lies not alone in the possibility of increased traffic or economy of operation, but in such limitation of capital investment as will keep the burden of interest account measurably below the savings effected.

A vital element in this investment is of course that relating to sub-stations and conductors. As to the latter, it is evident that greatly increased potentials are necessary to keep down their size, or with any given cost of conductor per mile to increase the distance between sub-stations, with resultant less aggregate investment in them and higher economy in operation. These are common requirements no matter whether alternating or direct currents are used. The bearing of the increase of potential upon the problem is quite evident from a consideration of the following general facts: When the traffic increases directly as the mileage the distance between sub-stations, with any given loss and size of working conductor, will increase directly as the increase of working potential; on the other hand, so long as the train load between sub-stations is not increased, this distance will increase as the square of the potential; but taking the average of service conditions on a trunk line, the allowable increase in sub-station distance will lie between these extremes. To illustrate: Doubling the working potential would probably on an average allow trebling the sub-station distances, and trebling the potential would very likely allow an increase to say five times in distance.

To meet the various economic requirements, and proceeding on the assumption that 500 to 600 volts is the limiting standard for direct-current operation, the principal energies of many engineers and manufacturing companies have of late been devoted to operation by alternating currents, with varying degrees of success as applied to railroads, with the abandonment of third-rail construction and adoption of a special type of overhead contact. These developments have resulted in a variety of designs for both polyphase and single-phase motors, and considerable divergence in views as to potentials, frequency, and mode of construction and operation where the single-phase has been adopted.

It is not my purpose at present to enter into a discussion as to the comparative merits of the various systems, each of which has its field of usefulness. I have long advocated and am keenly alive to the economic bearing of increased potentials, however obtained, but also mindful of certain practical features which must be considered in connection with them. I believe, however, that where alternating-current motor operation, with overhead construction, is adopted, there is little reason for halting at any moderate limit, but that such potential should be used as may be necessary, all things considered, to get a reasonably full measure of the possible economy of investment.

On the other hand, I have frequently pointed out that the limits of direct-current operation are by no means reached, and that five or six hundred volts was an arbitrary standard which present possibilities in construction of apparatus no longer warrants maintaining when leaving the field of tramways to take up the consideration of trunk line applications.

The time has now come, I think, in view of the developments which are taking place on the terminals of the roads entering New York City, the interest which railway officials are taking in the subject, and especially because of the various claims which are from time to time made, when equipment engineers, in considering the practical application of electricity to the more serious problems of railway operation, shall have as a choice the possibilities of higher limits in direct current as well as in alternating-current operation.

To that end I beg, therefore, to announce that if in any case, after considering the various kinds of equipment possible, it should seem from an analysis of all elements entering into the problem that a comparatively high-potential, direct-current equipment would produce the best net results, I am prepared to engineer and carry to a successful conclusion a direct-current installation at a working pressure, even on a third rail, of not less than 1,500 volts, which is at least two and a half times that ordinarily used.

I believe that it may be admitted that although oftentimes having taken a somewhat radical and advanced position in electric railway matters I have never made a public proposal which I have not been ready when called upon to carry out, and should conditions arise warranting an equipment such as is proposed, I propose to establish a new and necessary comparative standard in equipment possibilities. And I venture further to affirm that 1,500 volts is not the limit of practical direct-current operation.

The Electric Underground Road for Philadelphia.

For some time past an electric subway has been in process of construction in Philadelphia, under the management and control of the Philadelphia Rapid Transit Company, which operates the bulk of the surface trolley lines. The work now nears completion, and this week, on Monday, December 18, the first section of the subway was officially opened by the operation of surface cars through it on a five-minute schedule, these cars belonging to one of the divisions of surface cars which run out Market Street. The section of subway now in use extends under Market Street from Fifteenth Street to the Schuylkill River. After leaving the subway the cars cross the river on the new bridge erected by the Philadelphia Rapid Transit Company, connecting Philadelphia and West Philadelphia. The subway is not entirely completed from Fifteenth Street west. There are to be four tracks, two for express trains and two outside for surface cars.

For the express service the company will employ trains of all-steel cars, which after crossing the Schuylkill River, will continue out on Market Street, upon an elevated railway structure as far as Sixty-third Street. Owing to a strike in the building trades it will not be possible to put the elevated trains in service for some considerable time. It was thought desirable, therefore, to utilize the subway for surface cars meantime, and thus relieve the existing pressure on traffic facilities. The trolley cars for the present leave Market Street at about Thirtieth Street and cross the river on the new bridge. The local tracks in the subway are used as far east as the Nineteenth Street station, where the surface cars cross over on to the express tracks, and they then use these tracks to Fifteenth Street.

On December 16 about 500 prominent street and steam railway engineers and managers, city officials and others interested in elevated and underground traffic made an informal inspection of the subway, as the personal guests of John B. Parsons, president of the Philadelphia Rapid Transit Company. The guests walked through the underground passage, which was lighted by temporary fixtures as well as by the permanent lighting system of the tunnel. At 1 o'clock lunch was served at the Nineteenth Street station, which had been temporarily enlarged by extending the platform over the west-bound track. On Sunday, December 17, the Philadelphia Rapid Transit Company extended a general invitation to the citizens of Philadelphia to visit and inspect the subway, and more than 50,000 people crowded in to take this opportunity.

The completed subway section between Sixteenth Street and the Schuylkill River, at Twenty-fifth Street, is a small portion only of the proposed system. When completed there will be an elevated railway from Thirtieth Street to Sixty-third Street. The subway is to be extended east around the City Hall and thence under Market Street to Water Street, where it will emerge through a portal on to an elevated structure which runs north on Water Street and east on Arch Street to the Delaware River, and then south along the river front, a distance of a little over a half mile. This portion of the subway will be double-tracked and is for express trains only. The two outer tracks in the subway, which are to be used by the trolley cars, will branch off from the present subway at the City Hall and will make a loop through the business district via Walnut Street, Fifth Street and Arch Street. In this way the trolley cars bound east from West Philadelphia will run on the south outside track in the present subway, and after making the loop will return west by the north outside track.

The present subway structure has a width of 48 ft. 6 in. in the clear between walls, and 14 ft. 6 in. high in the clear, above the rails. Three intermediate lines of columns support the roof, which is designed to support the heaviest street traffic. The roof is formed of concrete arches, supported on steel I-beams, 5 ft. apart, placed

across the subway; the side walls are of concrete, reinforced with steel rods, and the floor is of concrete alone. Terra cotta ducts, with manholes at frequent intervals, are built in the south wall, forming the conduits for the cables conducting electricity for the operation of the railway and lighting the subway and stations. The roof over its entire length is water-proofed with asphaltic mastic 1 in. thick. The side walls are water-proofed where necessary with layers of burlap, coated with a compound consisting of the residuum from the refining of petroleum. The underdrains include two lines of terra cotta pipe, one under each outside track, with laterals passing to the exterior of the side walls every 50 ft. The main drains lead to a pump well at Twenty-second Street, where the water is discharged into a sewer by electrically-driven centrifugal pumps regulated automatically by floats.

The stations on the present section are at Fifteenth Street, Nineteenth Street, and at the east end of the Schuylkill River Bridge, near the line of Twenty-fourth Street. The latter station is designed to make connection with the Baltimore & Ohio Railroad station, and with the Fifteenth Street station is for both express and local trains. The stations at Nineteenth and Twenty-fourth Streets are intended for the trolley cars only.

The lighting circuits in the subway are entirely separate from the power circuits. The subway is divided into sections about half a mile in length, and the lamps at each station and for a distance half way to the next station on each side are supplied on a 110-volt circuit from a transformer located in the station. Each transformer sub-station is provided with a throw-over switch by which the lamps can be connected, if necessary, in groups of five, on to the railway circuit.

The track is quite novel as no ballast is used. The object is to keep everything in a perfectly sanitary condition, and the entire roadbed can be washed down with the hose and drained through sumps which are placed at frequent intervals. A different form of construction has been used in the express and in the local track. In the latter the rails are mounted on cast-iron chairs, which, with the rails, are completely embedded in concrete. This form of construction has been used for a number of years on the surface lines of the company with excellent results. The chairs or yokes are spaced 5 ft. apart and are provided at their upper ends with guide lugs in which are adjusting screws. The inside ends of these screws bear against holding blocks which grip the foot of the rail so that the rail is adjustable to exact gauge by manipulating the screws. The rails are laid in a trench left in the concrete which forms the rest of the roadbed. The rails are then aligned and the concrete is filled into the trench even with the top of the head of the rail on the outside and with the lower part of the head of the rail on the inside. In this way, if a rail has to be replaced, it is only necessary to remove the concrete in the trench. Sumps are provided in the local tracks at average distances of 50 ft.

On the express tracks, except at crossovers, the rails are mounted directly on yellow pine blocks 6 in. by 24 in. by 10 in., to which they are attached by clips and screw spikes. The longitudinal channels are set in concrete. The sumps on the express track are placed 500 ft. apart. One rail of each express track has been reserved for block signaling. The other rail is bonded with a protected bond and the two return rails are cross-bonded. The return circuit is then reinforced by a 2,500,000-cir.-mil cable. The local track rails are laid with the standard zinc joint of the Philadelphia Rapid Transit Company. The rails for both tracks are 90-lb. A. S. C. E. standard.

As the local tracks are to be used by surface trolley cars they are equipped with an overhead wire, which is supported in a special flexible suspension. This consists of two U-shaped brackets, which are attached to brackets set in the concrete roof of the tunnel while the latter was being built. The insulator hanger, which is of the usual bell type, is supported on a span wire connecting these two U-shaped brackets. The usual wooden guard plank is carried above the trolley wire. The express tracks and elevated structure will be equipped with a third-rail system. At present the express tracks will be equipped with the trolley system and will be used by the trolley cars until the elevated structure is completed.

Ventilation is secured not only by the openings into the street at the different passenger stations, but also by special chambers which are connected to stacks outside. Arrangements have been made at the base of these stacks for the installation of fans if necessary, but in most cases it is thought that the natural draft will be sufficient. There are three of these stacks on the section now completed, viz.: at Fifteenth Street, Nineteenth Street and Twenty-second Street. Similar ventilation shafts will be constructed on private property on the section of the subway which will next be opened, viz.: that east of Fifteenth Street.

For the present the surface cars will be used, but an order for 40 steel cars to be employed in express service has been awarded the Pressed Steel Car Company. These cars are provided with side doors as well as end doors, although it is not the present purpose of the company to utilize these side doors. In case the traffic increases, however, so as to cause any considerable delay in station stops, the seats will be removed and the side doors will be used. The platform doors are arranged to be opened pneumatically, as in the latest cars of the Boston Elevated Railway Company.

Electrolysis of Gas Pipes.

In discussing a paper on "High-pressure Gas Distribution of To-day," read by Mr. H. L. Rice before the meeting of the American Gas Light Association, at Milwaukee, Wis., on October 19, Mr. Frank S. Richardson related some experiences with electrolysis of gas pipes due to the current which escaped from a neighboring trolley railway. The power station for the railway is located at about the middle of a six-mile pipe line, and the pipe is connected to the trolley rail at this point in five places. About 600 ft. of pipe has recently been removed opposite the power house on account of the damage which had been done before the pipe was connected to the rail. One length of pipe had 27 pits in it, and three other lengths were pitted so badly that they leaked. Formerly there was an insulated joint in the pipe line at intervals of 500 ft., but the pipe has recently been bonded with No. 4-0 wire, making the line a continuous conductor. Experience indicates that it is best to have the line free from insulated joints and to bond to the rails wherever possible. Tests have shown that, due to the unavoidable potential drop in the rail portion of the electric railway circuit, difference in potential exists between the opposite ends of each insulating joint and current will pass from one length of pipe to the next by way of the soil. Observations have furnished conclusive evidence that insulated joints will not keep the pipe from being damaged, and that the best method is to bond the pipe joints.

Mr. Theodore Bunker stated that a difference of potential as high as 25 volts had been found between the pipe line from Camden to Trenton, N. J., which is laid parallel to a poorly bonded electric railway. A heavy copper wire was run from the pipe to the power house and after three years of operation, when the pipe was uncovered, it was found that no damage had been caused by electrolysis.

The Zambesi Power Scheme.

Prof. W. E. Ayrton in the London *Times* criticizes severely the Zambesi power scheme, the details of which have recently been given in these columns. He denies the possibility of such a scheme being commercially successful, and condemns the comparisons made between the power schemes at Victoria and Niagara, as the latter only delivers electrical energy over a distance of 30 miles while the former proposes to deliver it over 745 miles. At present the Rand consumes about 150,000 hp at a cost of something like $100 per year per horse power. Niagara sends 24,000 hp to Buffalo, 30 miles away, and sells it at 14 cents per horse-power-hour to an eight-hour customer, which is equal to $125 per horse-power-year. There is a plentiful supply of coal in the neighborhood of Johannesburg, and estimates have been obtained and accurate analyses made of about 20 different kinds of coal, giving the specific gravity and the percentages of carbon, ash, volatile matter, coke, as well as the evaporation factor, with the result that at a price of $2.60 to $3.00 a ton excellent coal can be delivered on the Rand itself. How is it possible, therefore, asks Prof. Ayrton, to "transmit electric energy 745 miles and sell it more cheaply than it can be obtained from coal on the spot?" He also points out the dangers from native interference with the line, and summarizes his objections to the scheme in the sentence that "such lengthy transmissions, more than three times as long as have ever yet been made, because more than three times as long as even the enterprising Americans have ever yet considered commercially possible, could certainly never succeed in such an unsettled country as South Africa."

Exhaust Steam Direct-Current Turbines in Philadelphia.

The Philadelphia Rapid Transit Company has just installed at its power station at Thirteenth and Mt. Vernon Streets an 800-kw Curtis low-pressure turbine, which takes steam from the engine exhaust. This station is equipped with four 1,500-hp and one 2,200-hp Wetherill Corliss engines, and as it is located at a distance from both the Schuylkill and Delaware Rivers, has always been run without condensers. An Alberger condenser and cooling tower with 8,000 sq. ft. have recently been erected, however, for the use of the low-pressure turbine. The cooling towers are 22 ft. in diameter and 41 ft. high and the rotary pumps for circulating the water in these towers are directly connected to a 120-hp inter-pole electric motor. The average vacuum attained in the condenser since starting a few days ago is 28 in., although it is said that a vacuum as high as 29½ in. has been secured.

The 1,500-hp engines are each direct-connected to a 1,500-kw generator which develops an average of about 2,000 amp. at 575 volts. The turbine takes steam from the exhaust main at a pressure of, say, 1 lb. above the atmosphere, and is provided with four wheels, each with a single row of buckets. Exhaust steam from one engine when operated at 2,500 hp or 2,000 amp. is sufficient to secure an output from the turbine of 1,300 amp. at 575 volts, with no increase in the back pressure on the engines. As about 150 amp. are required to operate the auxiliaries, the gain from the use of the turbine is from 1,000 to 1,200 amp., or approximately 66⅔ per cent of the output of the original generating unit, instead of the 25 per cent usually expected from the introduction of a condenser.

The generator portion of the turbo-unit is also interesting, as it is a direct-current machine, having six poles and running at from 1,100 to 1,200 r.p.m. The voltage is remarkably steady in spite of the fact that no governor is used on the turbine.

The turbine was put in service December 15 and tests are now being conducted to determine its steam consumption. The rated capacity of the turbo-generator is 800 kw at a speed of 1,200 revolutions. With the turbine receiving steam at atmospheric pressure without moisture and with 2 in. absolute back pressure in the condenser, a water rate is guaranteed of 36 lb. at full load and 40 lb. at half load. At 4 in. absolute back pressure the guarantee is 45 lb. and 50 lb., respectively. It is stated that on recent tests on this unit made at Schenectady these figures were met with a large margin to spare, thus showing that low-pressure turbines can be used to great advantage where a comparatively large amount of exhaust steam is available. The Philadelphia Rapid Transit Company has ordered a duplicate of the present unit.

To Begin Electrification of Erie Road.

In accordance with reports frequently referred to in these columns, the management of the Erie Railroad has now announced its intention to begin the construction of an electric line from Binghamton, N. Y., to Corning, a distance of 76 miles. The new line will parallel the present line of the Erie between these two points, and is intended to care for local passenger traffic. The surveys for the line are to be made immediately, and the contracts for the construction work will be let probably in January. This line will mark the entrance of the Erie Railroad into the electric traction field. In general its policy is the same as that of the New York Central and the New York, New Haven & Hartford Railroads. Both these roads have for some time been buying control of electric lines at points where the trolley lines seriously interfered with the local traffic of the railroads.

The cost of the Erie's electric line will be in the neighborhood of $1,500,000. This money, it is understood, will be provided out of the proceeds of the recently authorized $12,000,000 issue of convertible bonds. This first piece of electric road under Erie control is likely to be followed by the construction of other electric lines at various points where the Erie management may consider it wise to construct them. It has adopted this policy, it is said, in order to discourage the construction of electric roads paralleling the Erie lines.

The Erie's new line from Binghamton to Corning will be built along the present right of way, making a third standard track adjoining the two tracks which the Erie now has in operation between these points. The line will be so constructed that it will be available for the operation of the company's regular trains should occasion arise for such use of the new tracks. If the traffic on the new line warrants it, a fourth track, also equipped electrically, may be added.

The line, starting from Binghamton, will run through the towns of Union, Owego, Southboro, Waverly, Chemung, Elmira and Horse Heads, ending at Corning, where the northern line of the Erie diverges from the main line. There will be considerable local passenger traffic along the new line, and it is hoped to relieve the Erie's main tracks of its burden, leaving them to be used for through trains and for freight. It is probable that trains will be run on the electric line at intervals of an hour, or perhaps even closer together.

No decision has yet been reached by the Erie officials in regard to the electrification of its suburban lines running out of Jersey City. It is the ultimate intention of the management to electrify these lines, but how soon and in just what manner has not been determined. It is probable, however, that the further electrification of the Erie's lines will be undertaken at various points before the work is begun on the road's lines in New Jersey. Ultimately there will be an Erie electric tunnel under the Hudson into New York.

A High-Speed Suburban Road.

The end of the prolonged fight extending over four years for a franchise, first before the Board of Aldermen and then before the Board of Estimate, by the Port Chester Railroad Company, was reached last week, when the company persuaded the Board of Estimate to approve its application. The board adopted a resolution fixing terms under which the road may obtain a franchise to operate in the Bronx, but the action is tentative inasmuch as the terms have to be advertised for twenty days under the law, and also because the courts have not yet passed on the constitutionality of the act giving franchise-granting powers to the Board of Estimate instead of to the Board of Aldermen. Under the terms, as approved by the Board of Estimate, there are 42 sections, all of which have been accepted by President W. C. Gottshall of the road and by ex-Judge D. Cady Herrick as counsel. The franchise is to run for 25 years with the privilege of another like term on a revaluation. For the first five years the company is to pay $8,000 a year to the city, with $13,000 a year for the second five years, and $35,000 a year for the next fifteen years.

In addition the company will have to pay 5.4 cents per linear foot of track per year for the first five years, 7 cents per foot for the second five years, and 20 cents per foot for the last fifteen years.

In addition to these payments the terms demand that the company shall complete work to the value of $1,000,000 within five years from the date of the execution of the contracts. A bond for $100,000 guaranteeing the performance of this work must be deposited in the Comptroller's office. The company is prevented from mortgaging or selling out to any other company. There are to be no grade crossings, and the city is to be guaranteed from damage in operation. At least 60 trains per day in each direction are to be operated, with $50 penalty for each train under that number. The road is to be four-tracked south to One Hundred and Seventy-seventh Street and two-tracked down to the Harlem River, with a heavy high-speed electric service.

Gifts to Princeton.

The Princeton University trustees held a meeting at Princeton on December 14 at which was announced the receipt of $80,076 in gifts to the university since October. Announcement was made that the Supreme Court of Missouri had upheld the validity of the will of the late Dr. John S. Sayre, class of '78. From this the university will receive about $40,000, to be used for the endowment of a Fellowship of Applied Chemistry and a Fellowship of Applied Electricity, both in the John C. Green School of Science. The remainder of the bequest is to be used for the endowment of scholarships to be known as the Class of '78 Scholarships. In his will Dr. Sayre expressed the desire that his classmates should contribute an equal amount for the same purpose.

Electrical Engineers of the Times.—XLI.

MR. C. L. DE MURALT.

Carl Leonard de Muralt was born in Brooklyn, N. Y., January 29, 1873. His parents having moved to Europe while he was a child, his primary education was received in the schools of Zurich, Switzerland. After graduation from the Zurich Gymnasium, he studied five semesters at the Polytechnic of Zurich, and two semesters at the University of Munich, Germany, subsequently taking up some special research work under Prof. H. F. Weber at the Polytechnic of Zurich.

In 1895 Mr. de Muralt returned to America, where he entered the employ of the General Electric Company, first in the shops at Schenectady and then in the engineering department under Dr. C. P. Steinmetz. In 1897 he was detailed by the General Electric Company to the Union Elektricitäts Gesellschaft in Berlin, Germany, as engineer of the lighting and power department. Under this appointment he had charge of the design and erection of some of the most important plants installed by the Union in various European countries, among others the city lighting plant of Madrid, Spain, which was one of the first plants in Europe to use high-tension alternating currents in connection with a system of subterranean transformer sub-stations and distribution through an extensive underground cable network. In 1899 he entered the employ of Brown, Boveri & Co., of Baden, Switzerland, for whom he designed several large power transmission plants, including the in-

MR. C. L. DE MURALT.

stallation of the Fure & Morge Company, near Grenoble, France, which makes use of a large water power on the northern slope of the Alps and transmits the energy down into the French plains. There it is distributed to a large number of towns for use in small and large industrial establishments, notably silk spinning and weaving mills, paper factories, etc., the motor equipment for all of which was included in the contract. The transmission voltage of this installation is the highest used by any plant in Europe and the use of synchronous as well as asynchronous motors gives this plant a remarkably high power factor through the system. The building of the well-known Swiss three-phase, alternating-current railways by Brown, Boveri & Co. gave Mr. de Muralt an opportunity to do considerable original work in this interesting field, in which his firm acted as pioneers. He is a strong believer in the advantages of polyphase alternating currents for heavy railroad work and he has more than once given public expression to this opinion, even at a time when he was practically alone in taking this standpoint.

In 1902 Mr. de Muralt was called to America as consulting engineer for the Lake Superior Power Company, of Sault Ste. Marie. In the same year he established the firm of Muralt & Co., consulting and contracting engineers, New York, and he has since been connected with a number of important American electric propositions. He is a member of the American Institute of Electrical Engineers, to the *Transactions* of which he has contributed papers on "Polyphase Alternating Currents for Railroads" (1902), and "Heavy Electric Traction" (1905). He has contributed articles to the technical periodicals both in this country and abroad, and is the author of a leading article in the *North American Review* of May, 1903, on heavy railroading.

CURRENT NEWS AND NOTES.

DEAD AT THE BOARD.—A very unusual occurrence was the death last week at the switchboard of one of the girl operators in the Chelsea exchange of the New York Telephone Company. It was a case of heart disease, to which the young woman was subject; but the thorough care in selection of employes renders such an incident practically unique in telephone work.

MORE STREET DESTRUCTION.—The Great Eastern Telephone Company announced last week that it would begin to dig the ditches for its conduits in Manhattan and the Bronx within the next two weeks. "At the opening of spring," D. A. Reynolds, president of the company, said, "we shall begin work in Brooklyn. We hope to have the plant in operation inside of six months."

SOUTH AMERICAN CABLES.—The cable steamship *Faraday*, belonging to Messrs. Siemens Brothers & Co., having on board 1,750 knots of cable for the Central and South American Telegraph Company, has sailed for Valparaiso, where she is due to arrive about December 28. This cable is to duplicate the Central and South American Telegraph Company's system between Valparaiso-Iquique, Chili, and Callao, Peru.

RADIOACTIVE ELEMENT.—Instructor O. Hahn, working under Prof. Ramsay at the University College, London, claims to have found a new radioactive element. It is said that the new substance is nearly as active as radium and is a constituent of thorium, used in the manufacture of gas mantles. The substance has been named radio-thorium. Pending further details, the announcement does not reveal any very startling novelty.

HARTFORD ELECTRICAL SOCIETY.—The Hartford (Conn.) Electrical Society has elected the following officers: President, Prof. Henry A. Perkins; vice-president, Charles A. Hovey; recording secretary, A. G. Steele; financial secretary, S. W. Harney; treasurer, Frederick C. Hedrick; lecturer, T. H. Day. "Electric Light and Power Economics" was fixed as the subject of a lecture by Prof. Perkins before the society on the evening of December 21.

CAPITAL PUNISHMENT FOR STEALING WIRE.—A City of Mexico correspondent states that a bill has been introduced in the Mexican Congress to make the theft of copper wire, used for transmission purposes, punishable by death in case such theft causes fatal accident to any one. It is stated that over $30,000 worth of copper wire has been stolen from electric power concerns in the City of Mexico recently.

A FAILURE ABROAD.—A dispatch from Washington of December 9 states that Prof. Frank H. Roberts, of the University of Denver, was presented to the President by Representative Mondell, of Wyoming. Prof. Roberts returned recently from an extended trip in Europe, where he went to study the question of municipal ownership of public utilities. He visited Glasgow, Manchester, Liverpool, London, Brussels, Amsterdam, Antwerp, Hamburg and Berlin. He expressed to the President the opinion that public ownership of public utilities was a failure in Europe, and predicted that, in a few years, it would have few supporters even in Great Britain, where it has been popular.

MOTOR BOOTS are thus described in a special dispatch from Paris of December 16: "Parisians were startled yesterday by seeing a big-booted man whizzing along the Avenue des Champs Elysées, and thence to the Bois de Boulogne at the rate of 25 miles an hour. It was Constantini, the inventor of motor boots, displaying the new footwear. The boots resemble tiny automobiles, 15 in. long, fixed on high boots. Each has four rubber-tired wheels 8 in. in diameter. Accumulators are carried in a belt. They transmit by wires 1¼ hp to each motor. The motors can be run at a speed ranging from six to thirty miles an hour. Each boot weighs 16 pounds, but as the feet are not lifted up the weight does not matter. Constantini says he has traveled several hundred miles with them. He intends to travel from Paris to St. Petersburg on them. When asked what would happen if one motor started at the rate of six miles an hour and the other at thirty he became diffident and declined to discuss the subject." We should greatly like to see those accumulators.

STANDARDIZATION IN TELEPHONY.—Mr. F. R. McBerty addressed the electrical section of the Western Society of Engineers at Chicago December 15 on standardization in telephony. The topic brought out considerable discussion, as might be expected in a field where so much diversity now exists.

FRENCH ELECTRICAL DECORATIONS.—A Paris dispatch regarding the automobile exhibition in that city says that the scheme of decoration of the Grand Palais is entirely different from last year's plans. The decorations this year comprise 50,000 electric lamps, with a huge luminous sun in the center, surrounded by hundreds of luminous stars.

A CENSUS TEXT-BOOK.—The department of electrical engineering at Cornell University has recently adopted as a text-book the United States Census Bureau report on electric and street railways issued this year. The report, which is a large quarto volume of 439 pages, profusely illustrated, not only embodies the statistics of the art up to 1903, but gives a large amount of technical, economic, sociological and historical data.

WEST INDIAN WIRELESS.—A correspondent at Key West writes us: "It may be of interest to you to know that the wireless station at Colon, Panama Isthmus and the station at Key West have communicated with each other regularly at night since December 1. The large station at Manhattan Beach is heard every night at San Juan and Key West. Communication between sunrise and sunset over long distances has not yet been accomplished by these stations."

FOR UNION COLLEGE.—At a dinner of the Union College Alumni Association, held at the Hotel Manhattan last week, announcement was made of a gift by Andrew Carnegie. The General Electric Company has already presented the college with a building for electrical engineering, to cost $25,000. This Mr. Carnegie has now promised to equip at an expense of $100,000, provided the college itself raises another $100,000 to endow it. More than $20,000 has been raised in the last few days by the alumni and friends of the institution.

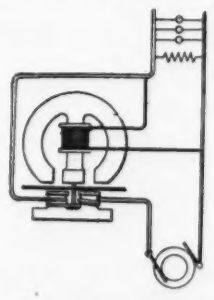
THE QUESTION BOX.—President Blood has appointed Mr. Paul Lüpke, superintendent of the Trenton division of the Public Service Corporation of New Jersey, editor of the "Question Box" for the twenty-ninth convention of the National Electric Light Association, to be held next May or June. Mr. Lüpke has been from the first one of the most enthusiastic admirers and close students of the "Question Box," and is a firm believer in its value to central stations. He is himself a thorough engineer and will undoubtedly make this year's work at least the equal of its predecessors.

THE NOBEL PRIZES.—Rules regarding the awarding of the famous Nobel peace prize have been received by the Department of State. All proposals of candidates for the prize which is to be distributed December 10, 1906, must be laid before the Nobel Committee of the Norwegian Parliament by a duly qualified person before the 1st of February of the same year. Any one of the following persons is held to be duly qualified: Members of the Nobel Committee of the Norwegian Parliament, as well as the advisers appointed at the Norwegian Nobel Institute; members of Parliament and members of government of the different states, as well as members of the Interparliamentary Union; members of the International Arbitration Court at The Hague; members of the Commission of the International Peace Bureau; members of the Institute of International Law; university professors of political science, and of law, of history and of philosophy; and persons who have received the Nobel peace prize. The grounds upon which any proposal is made must be stated; every written work, to qualify for a prize, must have appeared in print. For particulars qualified persons are requested to apply to the office of the Nobel Committee of the Norwegian Parliament, Drammensvei 19, Christiania.

AMUNDSEN'S WORK.—Writing with regard to Amundsen's work in locating the magnetic north pole, and the value of the determination, Prof. W. Hallock, of Columbia University, says: "Is it not natural that our pulse should quicken at the narration of the brilliant achievement of the Norwegian who shut himself in the frozen north, and while his fellow-countrymen were making a new kingdom and a new King he made for himself a place in history as enviable and as lasting as that of any King? When Roald Amundsen pitched his little settlement upon the shores of King William Land and proceeded to set up his magnetic apparatuses in the chilly prospect of spending two years in watching them, and then possibly succeeding in getting home with his records, he faced a proposition that might well stagger the bravest. This was no rampart that could be stormed with a glorious dash, to the sound of music, and before the eyes of admiring fellows. Here was what Horace so aptly described as *'vir tenax praepositum,'* a man so tenacious of his undertaking that he had no suspicion of the possibility of failure; who succeeds because he sets out with the firm conviction that he will succeed. In 1831 Ross located the 'magnetic pole' on the west shore of Bootia Felix (Boothia or Boothia Isthmus); it was approximately located about 60 miles farther west in 1879, and here this persistent hunter camped as near its trail as possible, and provisional reports indicate that it is now 'near Boothia Felix.' The scientific world is waiting with considerable impatience for his results. They are reported as 'very satisfactory,' and in that case they will stand out absolutely unique. Two years of successful observations at that point are a treasure without price."

CASCADE CONNECTION OF POLYPHASE INDUCTION MOTORS.—A patent issued December 12 to Mr. Coloman de Kando, of Budapest, Austria-Hungary, relates to the operation of polyphase induction motors at variable speeds for railway work. The inventor proposes to use a plurality of cascades of induction motors, each motor having a three-phase primary and a three-phase secondary winding. Thus with a four-motor equipment, there would be two cascades, each containing two motors. Under the usual method of operation, this arrangement would permit of two economical speeds. According to the arrangement disclosed in the patent, however, there are three economical speeds—namely, the highest speeds with only the two leading or primary motors of the cascades in operation, the propelling power being that due to the operation of these two leading motors; second, an intermediate speed due to the series connection of the two motors in each cascade, whereby a propelling power of four motors is obtained at this intermediate speed, and, third, a low speed with the leading motor of one cascade cut off from the source of supply and the second motor of this cascade switched in series with the two motors of the other cascade. In the latter case, the propelling power is due to the operation of three motors at the slowest speed.

INDUCTION WATT-HOUR METER.—A simple form of watt-hour meter is disclosed in a patent issued December 12, to Messrs. William Hamilton and S. Z. Ferranti. As indicated in the accompanying illustration, the shunt-wound magnet, which is disposed above the outer portion of the revolving disk, has three limbs, on the central one of which the coil is placed, so that at any instant when the central limb is of a central polarity the two outer limbs are of the opposite polarity. The two poles of the series-wound magnet, which is below the disk, are arranged practically opposite to the poles of the shunt-wound magnet. In order to obtain a



lag of 90 degrees of the effective torque producing flux behind the impressed electromotive force of the shunt coil, the leakage of magnetic lines is made considerable by placing the shunt coil high up on the central limb and providing the lower part of this limb with an additional metallic cross-section, the effect of which is to produce a further lag in the magnetic flux which enters the revolving disk. The inventors state that it is possible and convenient thus to produce an excessive lag, and to reduce this to exactly 90 degrees by means of a series non-inductive resistance.

RUSSIAN TELEGRAPH STRIKE.—A special dispatch from Russia, dated December 13, says: "The Government is making little headway in crushing the telegraph strike. The wires of the few lines over which service had been temporarily restored are constantly cut, and not a single wire is working out of St. Petersburg this morning. The new committee of the Postal-Telegraph Union has decided to continue the strike until the strikers' demands are completely satisfied."

THE NOBEL PRIZES.—The new Nobel Prizes, awarded this week, include the following: Physics, Philipp Lenard, professor at Kiel University, for researches into cathode rays. Chemistry, Adolph von Boeyer, professor at the University of Munchen, for researches leading to the evolution of organic chemistry and the development of the chemical industry. Each prize amounts to about $40,000. The awards are distributed at the Royal Academy of Music by King Oscar and all the members of the royal family and of the diplomatic corps are expected to be present.

ELECTRIFIED WEST SHORE.—A special telegram from Utica, N. Y., of December 14, says: "Three large trolley cars filled with railroad officials and other guests this afternoon made the formal trip from this city to Little Falls, running about three miles over the West Shore Railroad. To-morrow the new line will be open for regular business and eighty trolley cars a day will hereafter be run over the electrified portion of the steam railroad. This is the first section of the West Shore to be used by trolleys. It is expected that within a year the road will be used for trolleys between Utica and Syracuse." Data with regard to the service and equipment appeared in these pages last week.

MAGNETIC POLE DATA.—A special telegram from Seattle, Wash., of December 15 says: "The information that the Norwegian explorer, Capt. R. Amundsen, who discovered the northwest passage, had made magnetic observations, was conveyed to this city in a cable dispatch addressed to Major W. A. Glassford, and signed by Capt. Hartman, of the Signal Corps at Valdez, under date of December 12. The dispatch also states that an observation station had been maintained for two years in latitude 68° and 30′ North and 90° West, and that the data acquired corroborate the magnetic observations of Sir Charles Ross. These observations are expected to be of the utmost importance to scientific men and mariners navigating northern waters."

MEDALS FOR SUBWAY.—The last meeting of the New York Chamber of Commerce was devoted to the presentation of gold medals to the following members of the Rapid Transit Commission who are also members of the Chamber: Alexander E. Orr, Morris K. Jesup, John Claflin, Woodbury Langdon, Seth Low, John H. Starin and Charles Stewart Smith. On one side of the medal is a cross-section view of the subway and on the other side the name of the owner. The committee which presented the medals called attention to the fact that the Chamber of Commerce initiated the plan and prepared the bill passed by the Legislature on May 24, 1894, under the provision of which the subway was built. The committee also reported that a book on rapid transit, to be issued by the Chamber, is now being prepared.

TAXING SLOT TELEPHONES.—The city officials of Montreal intend to put into force the new by-law in regard to taxing slot machines. The following is the clause in the by-law imposing the tax: "Section 11.—No person, firm, company or corporation shall have under his control or in his possession any slot machines, in which the public is allowed to drop money, without having previously obtained a license from the city and without having paid to the city treasury certain sums." The tax was assailed by the Bell Telephone Company, which held that the city had not the right to impose it. The recorder has upheld the action of the city in this connection; in consequence of the judgment the by-law will be put into force and the company in question will be called upon to pay the tax, the same as any other company or individual. Officers of the company state that the decision, which compels them to take out licenses at a stated sum annually for all slot telephones, will not, even if enforced, cause them to abandon the system generally, though it would cause them to withdraw instruments which are now earning very small sums.

THE CARNEGIE FOUNDATION.—Dr. Henry S. Pritchett, formerly president of the Massachusetts Institute of Technology, will begin his work as president and executive officer of the $10,000,000 Carnegie Foundation on January 1 with a permanent residence in New York, at 542 and 544 Fifth Avenue. The Carnegie Foundation, which Mr. Carnegie established with a gift of $10,000,000, is designed to aid deserving and elderly teachers and professors and make possible larger opportunity for research work. In its executive committee are many of the presidents and most prominent instructors of the institutions of learning in the United States. Dr. Pritchett took charge of the Massachusetts Institute of Technology five years ago. Previous to that time he was superintendent of the United States Coast Survey, statiioned at Washington. He is a native of Missouri and a graduate of the University of Munich.

ABOUT LORD RAYLEIGH.—The distinguished English physicist, Lord Rayleigh, has been elected president of the Royal Society. He has taken all physics to be his province, and has worked to reduce them to a compact homogeneous system. The discovery of argon made him known to the general public, but this was only part of the results of a delicate investigation intended to throw light on the gaseous state of matter. Few physicists have a more extensive record of achievement. Nevertheless, Lord Rayleigh has found time for public affairs as well. He held the Cavendish professorship of experimental physics at Cambridge University for five years, and there conducted those absolute electrical determinations which have been part of the foundation of practical measurement in electrical engineering. He was secretary of the Royal Society for ten years, and has presided over the development of the National Physical Laboratory.

THE WATERWAYS COMMISSION.—It is stated from Washington that in order to prevent international complications growing out of the indiscriminate use of the waters of the Sault Ste. Marie by Canadian and American power companies an effort will be made in the near future to secure the adhesion of the two countries to an agreement, recommended by the International Waterways Commission, to withhold the issue of any further rights or privileges for the diversion of these waters until the commission has collected enough data to formulate joint rules to regulate the disposition of the water. Rival power companies on both sides of the river are trying to extend their plants, and the commission has pointed out to the War Department that the future navigation may be seriously jeopardized unless some regulations are adopted that shall be binding upon both sides. The acceptance of the commission's recommendation, which is regarded as probable here, would imply the continuance of the body for another year at least, and it may be that in the legislation that will be proposed to Congress by Secretary Taft provision will be made for a permanent international waterways commission.

MORE TUNNELS.—Delegations from various sections of the city attended the meeting of the New York Rapid Transit Commission on December 14 until the place was jammed. One delegation of 250 from Brooklyn, present on the suggestion of the Bensonhurst and Bath Beach Subway Association, urged additional subway service through those sections of the city. The speakers urged that the residents were entitled to subway accommodations, and they wanted a line extended from the Flatbush Avenue terminal. Delegations from the Ozone Park Board of Trade and from other sections of Queens were heard, suggesting changes in the proposed Jamaica Avenue line, so that the residents of Ozone Park would have a subway loop. The Washington Heights Taxpayers' Association likewise had a grievance, as had the North Manhattan Taxpayers' Association also. Both organizations wanted to know why the Washington Heights section of the subway has not been opened north of One Hundred and Fifty-seventh Street. Speakers declared that the subway was completed to King's Bridge and that the tracks were being used for switching and car storage purposes. The plan for the extension of the Flatbush line of the Brooklyn Tunnel of the Interborough Rapid Transit Company, submitted also at a recent meeting of the Rapid Transit Commission by the Park Department, is looked upon with some favor by the Interborough interests. Heretofore it had been proposed to run the sidings for the storage of cars underneath the parks. The new plan is to run the sidings under a vacant lot opposite the parks.

FRANKLIN'S BIRTHDAY.—The two hundrelth anniversary of Benjamin Franklin's birthday was celebrated by the Pennsylvania Society of New York, on December 12, at the Waldorf-Astoria, on the occasion of the annual banquet. The date is in reality January 17. Some 500 members and guests were present. Among the speakers was Mr. F. P. Fish, whose toast was "Franklin as a Scientist."

TELE-STEERING.—The following item is a reminder of the work done in the same field some years ago by Mr. Tesla in New York: "The London *Telegraph* of November 10, furnished by Consul Brittain, of Kehl, reports an interesting experiment in the outer harbor of Bilboa, Spain. It consisted in driving and steering a boat by electric power stationed some distance away; that is to say, the propellors were worked by electric waves transmitted without wires. The inventor, Senor Torres Quevedo, considers it possible to apply his system to aerial navigation. A large crowd witnessed the experiments, which were regarded as a great success."

POWER IN CENTRAL NEW YORK.—The Hudson River Electric Power Company, of Albany, which is supplying power to the Utica & Mohawk Valley Railway Company, for the operation of its traction lines between Rome and Little Falls and in the city of Utica, has been notified by the latter company that it will require additional power, as the result of the electrification of the West Shore Railroad, between Utica and Syracuse, which is controlled by the Vanderbilt interest. This request is very gratifying to the officials of the power company and especially so in view of the fact that the Ontario Power Company, at Niagara Falls, was endeavoring to secure this contract. The power company has been supplying power to the railway company since July 1, 1905, and has erected a 5,000-hp steam turbine plant at Utica to take care of this work.

NEW YORK FIRE PROTECTION.—The National Board of Fire Underwriters in its report issued last week condemned the conditions in the Boroughs of Manhattan and the Bronx regarding the risks by fires. Capt. Sewell of the United States Engineers, who assisted in the examination and investigation, asserts in the report that the general situation in Manhattan is by far the most serious fire and conflagration hazard known to him. The reasons for this, it is pointed out, are the many narrow streets in the older part of New York city, the type and occupancy of buildings, and the enormous hazard involved because of the inadequacy of the water supply and the distribution. The Fire Department is not criticised outright, but the engines are said to be deficient in size and generally in poor condition. "Discipline and methods are fair," the report goes on to say, "service as a whole efficient and powerful." It is recommended among other things that the electrolysis of water mains be thoroughly investigated. The fire alarm system in both boroughs is criticised as being "extremely defective."

WIRELESS. INTERCEPTIONS.—A note as to the wireless telegraph practice by the United States Signal Corps away inland at Leavenworth, gives some interesting items as to unexpected interceptions. While Major George Squier, chief of the signal school for officers, and Capt. Mitchell were flying kites 7 ft. high and 5 ft. broad connected with a wireless instruments they intercepted a message sent from President Roosevelt on board the *West Virginia*, going from New Orleans to Washington, a distance of 2,250 miles from Fort Leavenworth. The wireless operators caught a message the same evening from a young woman on the *Concho*, of the Mallory Line, in the Gulf of Mexico. It was intended for the wireless receiving station in Galveston, Texas, and was to be forwarded from there to Austin. Their greatest feat was intercepting a message from the Standard Oil Company steamship *Maverick*, sent when that vessel was off the coast of Porto Rico. The Signal Corps men would not believe they had intercepted a message from so great a distance until they had written to New York and learned that such a dispatch had been sent.

CONTINENTAL MINE POWER.—Mr. C. Smith, in an article in the December *Mines and Minerals*, says: "The use of electrical power in mines is rapidly increasing in extent since mine owners are finally realizing in their study to attain greater economy in present existing methods, that this form of energy is best adapted to their needs; and the purposes for which power is required are perhaps greater in this line of work than in any other industry. On the continent of Europe, especially where competition is keen, general recourse has been had to electrical power during the last few years. In considering the reasons for this we have in some cases simply to consider the facility and economy with which electrical power can be transmitted from one central station to a great distance. Take for instance a group of mines scattered over a large area. Here these two advantages alone, namely, centralizing the power generation and economy of transmission, render electrical power unsurpassed for the purpose. Even considering a single mine, the total lengths amount to considerable, especially if a deep-level mine."

ENGLISH CONTACT ROADS.—United States Consul Mahin, of Nottingham, reports recent efforts to do away with the overhead trolley in England. The plan employed is surface contact: "The town of Lincoln, with 50,000 population, 33 miles northeast of Nottingham, has adopted a street railway system which has several unique features. Construction is now under way. The line will be about a mile and three-quarters in length, eight cars will be used and the entire cost will be about $140,000. The system was adopted by the Lincoln City Council after long and careful investigation and consideration, and the securing of guarantees that place the corporation beyond possible risk of loss, such, for instance, as an undertaking by the constructors of the line to equip it with the familiar trolley if their system failed to work satisfactorily. The system adopted is known as the 'G. B. surface contact.' The initials stand for Griffiths & Bedell, the patentees. The inventor is Mr. B. H. Bedell, an electrical engineer. The invention was substantially completed in 1904, though some modifications have since been introduced. An experimental line has been operated near London for over a year, but Lincoln is the first town to adopt the system. A dozen or more surface-contact systems have been tried and submitted to the judgment of tramway engineers and municipal authorities, but, if I am correctly informed, the 'G. B.' is the first British invention to be adopted for practical use in this country. It is claimed, being the latest, to have eliminated all the faults discovered in other systems and to be as near to absolute perfection as is possible. An American surface-contact system, the Lorain, has been operated at Wolverhampton for the past three years. The last report of the tramway committee of that city's council says the operation of the system has been satisfactory."

SAVED BY WIRELESS.—The wireless has just aided effectively in saving human life. While the Nantucket South Shoal Lightship No. 58, chained to a spot far out in the North Atlantic, was plunging about on December 10 in the severest storm so far this season, a leak was discovered in the fireroom compartments. It let in the water so steadily that when wireless communication ceased at 3.30 o'clock the fires had been extinguished and the vessel was helpless. It was 9 o'clock a.m., while the storm was at its height, that the naval wireless station at the Newport, R. I., torpedo station received a message stating that the lightship had sprung a leak early in the day, and that although the pumps had been kept constantly at work, the water was gaining. The water appeared to be coming in somewhere above the fireroom plates, but the leak could not be definitely located. Three hours later another message was received saying that the water was still gaining, and asking that assistance be sent as soon as possible. At 3 o'clock it was announced that the fires had been extinguished and that the fireroom had been flooded. The gale at the lightship had backed in the northwest, which had kicked up a heavy cross sea. At 3.30 wireless communication ceased, indicating that the dynamos had given out. The last message received at the naval station was: "Water gaining; we are helpless." As the lightship was equipped with five water-tight compartments, it was believed by the lighthouse officials that she would survive the gale, which at that time was backing into the northwest. Nevertheless, every effort was made to go to her assistance. As the sea was very heavy off shore and none but the stoutest vessels could be used, it was found that the gunboat *Hist* was the only one available in port. Just as she was about to leave her steering gear gave out. The lighthouse officials in Boston, however, dispatched the lighthouse tender *Azalea* from New Bedford, and the revenue cutter *Gresham* also started. The lightship sank soon after the rescue of the crew and electrical staff had been effected.

Electricity Direct from the Coal Mine at Radcliff, England.

FIG. I.—COTTON MILL WITHOUT CHIMNEY.

IN connection with the suggestions which have been heard frequently concerning the relative economy of transmitting energy in the form of electricity directly from the coal mine or conveying the coal by rail to the place where the energy is needed, a description of an electric generating equipment which has recently been placed in operation by the Lancashire (England) Electric Power Company should prove of interest.

The power station is situated on the left bank of the River Irwell, and is contiguous on the other side to the Lancashire & Yorkshire Railway. The site adjoins the Outwood coal mine, so that an abundant supply of coal and condensing water is assured. It is believed that, by keeping the fuel cost at the minimum value by using the cheapest coal in the best and most efficient machinery, the expense of operation will compare favorably with that found with hydro-electric transmission schemes.

A feature which renders the site chosen particularly advantageous resides in the fact that the local railroad from the mouth of the mine is some 50 ft. above that part of the land on which the power station is built, so that coal can be taken directly from the mine cars to the grate of the boilers entirely by gravity. Coal is conveyed from the pit mouth in trucks which are shunted on to a side track back of the power house by an electric locomotive, to which is also fitted a 10-ton jib crane for tipping purposes. At the end of, and under the siding, is fitted a containing hopper into which the coal from the trucks is emptied. Under this hopper again is a small railway running down an incline, and at right angles to the siding. Coal is conveyed down this in a small truck, into which it is weighed in one-ton lots from the hopper. Gravity takes the truck down the inclined railway into the top of the boiler house and over the bunkers, where a toggle on the truck engages with a trip set at the bunker it is required to fill, and the sides of the bogie fall open, and it is emptied practically instantaneously; the empty truck is then returned to its original position under the siding hopper by a falling weight, which had previously been lifted by the truck on its downward journey. The coal is fed from the bunkers by chutes onto the grates, which are of the chain type, driven by electric motors.

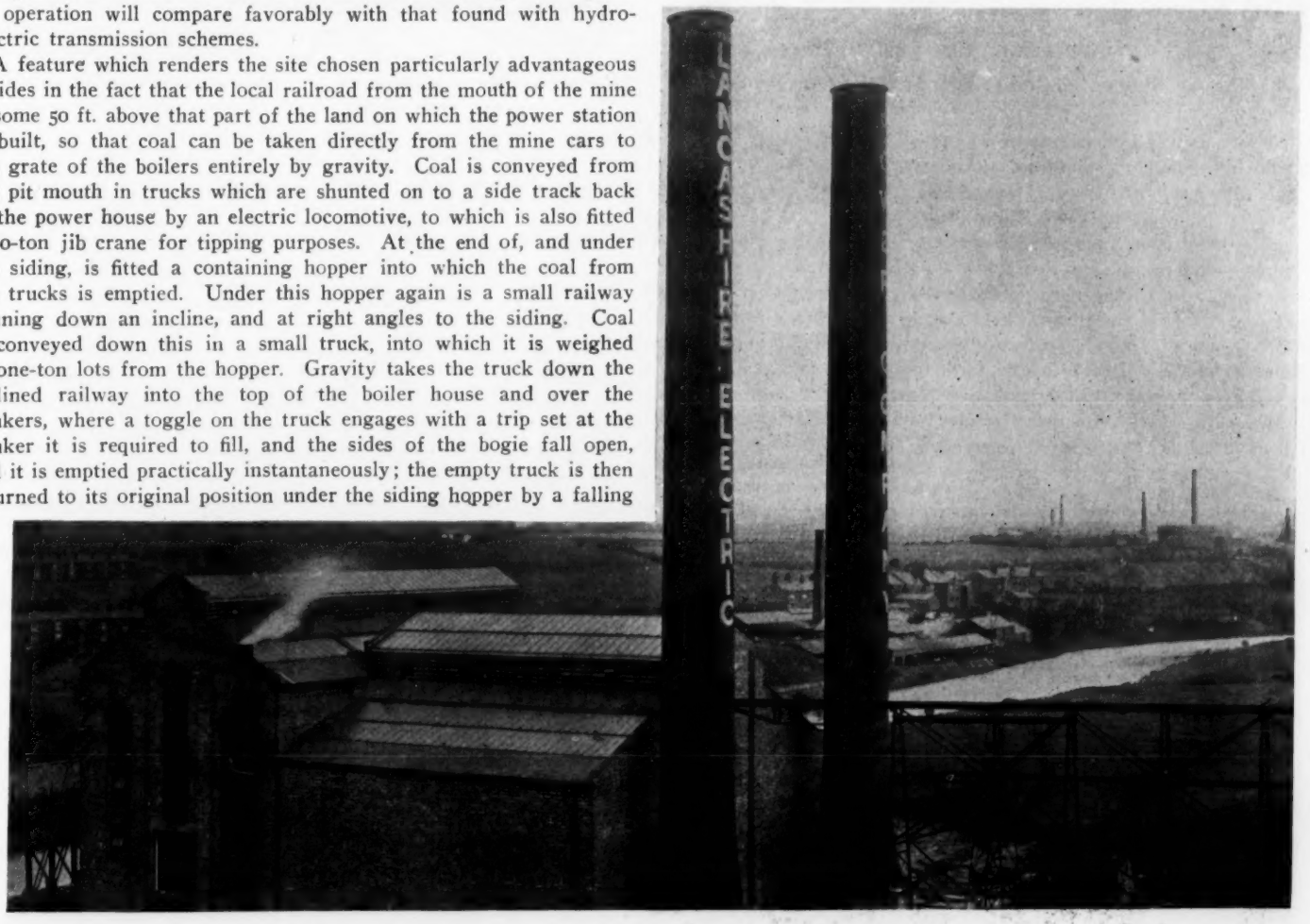


FIG. 2.—VIEW OF POWER HOUSE, SHOWING COAL-HANDLING DEVICE.

As seen from the sectional view of Fig. 3, the power house consists of a boiler and a turbine room. The house is of steel work construction, filled in with brick, built on a foundation slab of concrete, 3 ft. thick, stiffened by a grillage of steel girders. This slab forms the floor of the basements. Nine feet above the foundation slab are the floors of the turbine room and the boiler room, which are composed of steel girders with concrete on corrugated iron formers. The dimensions of the boiler room are 70 ft. by 80 ft., and of the turbine room 100 ft. by 50 ft. These dimensions are remarkable, inasmuch as 8,000 kw of generating plant is contained in the building, whereas perhaps a generating plant of one-tenth the power would suffice to fill it according to less up-to-date methods.

The boilers, of which there are six, are of the Babcock & Wilcox water-tube type, with superheaters. Each is capable of evaporating 20,000 lb. of water per hour from 60° F., to steam at 160 lb. per square inch pressure, and 150° F. superheat. The heating surface of each is 5,730 sq. ft., and the grate area 100 sq. ft. They are arranged in two banks of three, one bank on each side of the boiler room. Each bank has its own flue beneath the boilers, which is led out to its own brick-lined steel chimney, 150 ft. high and 10 ft. diameter. The ashes and clinkers fall from the back of the chain grates into the basement, from whence they are taken away in trucks on an industrial railway. The hot-wells are in duplicate at the turbine room end of the basement. There are no economizers, the feed water being heated by the exhaust from the exciter sets. The make-up water is taken from the local supply mains.

The steam from each boiler is fed into a ring of piping, so that in case of mishap the steam can be fed either way round the ring to the turbines, etc. The steam is brought through the wall dividing the engine room from the boiler room, each turbine being fed direct from the steam ring in the boiler room. A branch is also brought through for feeding the exciter sets.

The generating equipment consists of four 2,000-kw Curtis turbo-generators, made by the British Thomson-Houston Co., of Rugby, England. Each generator delivers 50-cycle, three-phase current directly at 10,000 volts, the transmission pressure. Each set consists of a vertical steam turbine and an alternator, mounted on the same shaft.

The turbines being vertical, the whole of the weight of both the turbine diaphragms and also of the rotating element of the alternator is borne by the vertical shaft; the bearing on which this rotates is of a very special construction. The bottom end of the shaft is finished flat and rests in a cup-shaped bottom block, which is capable of being raised or lowered by means of a suitable screw. Through the center of this block is bored a hole through which water is fed at a pressure of 400 lb. to the square inch; this raises the shaft from the block, and the water comes out in a constant film, about one-thousandth of an inch thick, and escapes round the top of the cup; the bearing is practically frictionless. The water at this

pressure is provided by two force pumps, one capable of dealing with all the turbines and one a spare; these are triplex pumps and are electrically driven, as seen in Fig. 4. As it is of utmost importance that the water should not fail, there is a water accumulator, which consists of a ram provided with heavy weights, and is so arranged that if the pump fails the accumulator gives the supply, at the same time ringing an alarm bell, allowing ample time for the attendants to start up the spare plant.

The condensers are placed right against the turbines, and the air pumps are directly beyond; the whole making very compact units. The condensers are of the vertical type with very ample surface,

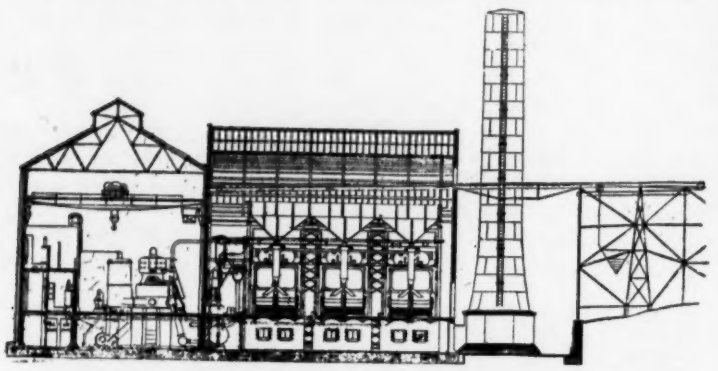


FIG. 3.—SECTION THROUGH TURBINE AND BOILER HOUSE.

so as to obtain a high degree of vacuum. The air pumps are of the triplex type, and driven direct by motors.

The excitation for the turbines, as well as the current for all the auxiliary plant, is obtained from three 150-kw, direct-current dynamos, direct-connected to reciprocating high-speed engines, which run non-condensing, the exhaust heating the feed water as mentioned before. In the engine room is also a dry-air pump; this keeps the water part of the condenser free from air and keeps the circulation good by maintaining a syphonic action in the circulating system; the pump also is used to prime the circulating pumps. There is a 25-ton electric crane which travels the length of the engine room.

The main cables from the generators and all the other cable work are fixed to the ceiling of the basement, being thus in sight and at the same time in a safe and convenient position. They are brought

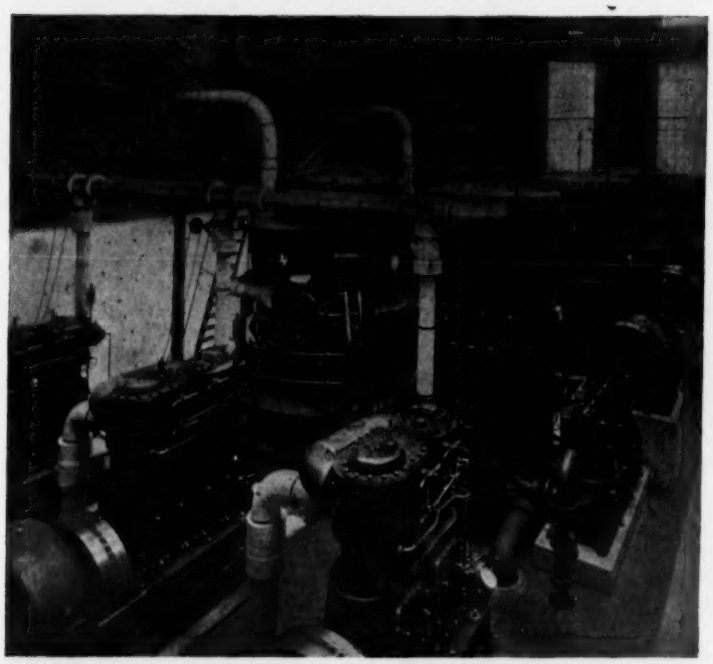


FIG. 4.—STEAM TURBINES, MOTOR-DRIVEN PUMPS AND STEAM EXCITER SETS.

through the wall into the switch rooms. These are in three stories, one on the basement level, one on the engine floor, and the third on the operating gallery above. In the basement are the potential transformers. These are for reducing the pressure from the generating voltage to that suitable for operating the voltmeters. These transformers are each partitioned off in brick chambers. On the floor above are the first main switches. The current is led directly from the generators to these, which are motor-operated switches, each in its own compartment. Each switch is of the plunger type, having three limbs, one for each phase. The current is brought to

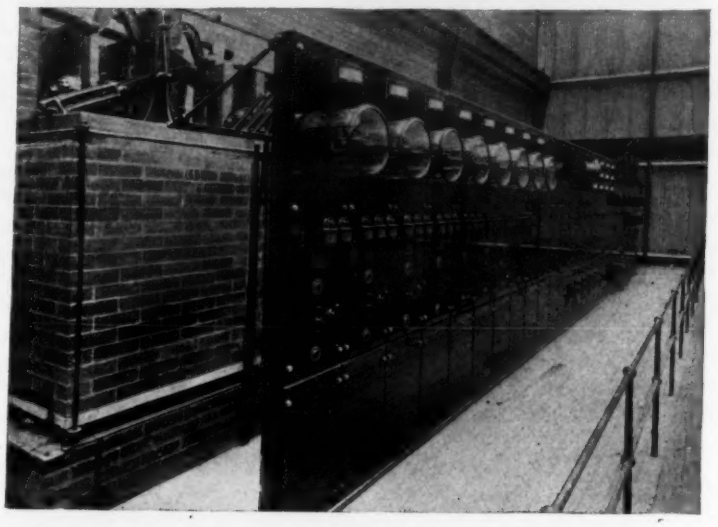


FIG. 5.—SWITCHBOARD AND REMOTE-CONTROLLED OIL SWITCHES.

a contact which is in the bottom of a tube, on the top of which is an insulator through which a plunger passes. The tube is filled with oil, so that when the contact is broken the arc is extinguished by the oil. These plungers are connected to wooden rods passing through to the operating mechanism which consists of a small motor and a system of strong springs; the motor is connected by a magnetic clutch to the levers, and on being started releases one spring, closes or opens the switch and compresses the spring in the opposite direction. The current now passes to the bus-bars. These are in the center of the same chamber, and are of bare copper supported on insulators enclosed in brickwork with suitable holes for inspection; they are in two sections, each section taking two machines. From the bus-bars the current passes to the floor above to other oil switches which connect the feeder circuits on to the bars; each circuit has two mains, and one of each of the mains is connected to the various bars so as to give additional safety. From these circuit switches the mains pass out through the walls on to the overhead construction; before leaving the building they are connected to a lightning arrester device for preventing undue rises of pressure, which consists of a series of metal discs placed in a row, with carbon resistances in series, and the end connected to earth.

The control mechanism for the oil switch motors, and in fact all the controlling apparatus in the station, is mounted on the operating board; low-tension current from the exciter circuits being used to drive the switch motors. Current from the current transformers operates the ammeters and automatic cut-outs; the voltmeters are operated from the special potential transformers described above; thus, no high pressure is brought near the operating board, no heavy current and no big switches are there, and so the handling is extremely simple, one man being able easily to deal with the whole plant. The arrangement also is very safe, for there are no large powers to cause electrical fires, and even in the case of some small mishap the main cable cannot be affected, and the supply in consequence is not interfered with. All the current from the exciter sets is brought up to a low-tension board at the end of the operating gallery and distributed from there. The engineer's offices are in the same line as the switch rooms.

The mains leave the station overhead, and are partly underground and partly overhead, as may be most suitable. The underground cables are three-core, paper-insulated, lead-covered, wire-armored, laid in bitumen in wooden troughs. Already many contracts of great interest have been entered into, notably one with the Acme Mill (Fig. 1), which has 75,000 spindles, of both the mule and ring type. The Pendlebury Spinning Company has a steam-driven mill of the same size adjoining, so that electricity will have a good chance of proving its superiority. Many other works, covering a variety of industries, are also to be supplied with power.

Regulation and Compounding of Lighting Balancers.

BY BUDD FRANKENFIELD.

THE problem of predetermining the regulation of a direct-current lighting balancer is complicated by the very simplicity and well-understood principles of the component apparatus involved. Just as a crystal presents many facets, each throwing off a little light, so in the balancer problem numerous probable solutions are presented; and one is confused in the selection of a point of attack. There are several other problems peculiar to the combination of two armature windings into a balancer set, which make the apparatus an interesting study, but they are beyond the scope of the present article.

A balancer consists of either a dynamotor or a motor-generator, and its object is to equalize the pressures of a three-wire lighting system fed from the bus-bars of a two-wire plant. Figs. 1, 2, 3, 4 and 5 illustrate several arrangements which have been used as balancers.

In Fig. 1 + and — are leads from the station bus-bars, which connect with the balancer and with the feeders of the lighting system. The neutral, ±, connects only with the lights and the balancer. The two armatures are mechanically coupled and each revolves in an independent field, the winding of which is often connected across the mains. When the load is balanced the two armatures operate as motors running idle. If there is an excess of load on the right-hand side of the system, the pressure of that side will drop below the counter e.m.f. of the low-voltage machine, which will begin to operate as a generator, drawing power from the other machine, which continues to operate as a motor. This generator action supplies the required neutral current and keeps the voltage on the right from falling an excessive amount, and the voltage on the left from rising an excessive amount. An excess of load on the left side causes the right-hand pressure to rise and increase the speed of the low-voltage machine as a motor. The increase of speed augments the generator e.m.f. of the high-voltage machine, whereupon it operates as a generator connected in parallel with the station bus-bars, and again the unbalancing of pressures is arrested.

The operation of the arrangements shown in Figs. 2, 3, 4 and 5 is in general the same as that of Fig. 1, except that a rise of pressure on either side, if lightly loaded, produces a motor action in the corresponding armature while the fall on the opposite side acts simultaneously to produce a generator action in the other armature; that is, there is a change in terminal pressure of each armature acting as a first cause in the process of equalization, while in the arrangement of Fig. 1 only the low-voltage armature is subjected to an external first cause. The arrangement in which an armature is connected across each side of the system furnishes a more sensitive unit. Another point of difference is that in the arrangement of Fig. 1 all the power represented by the current in the neutral wire must undergo, or be the result of, a transformation, the current in the neutral wire being that of the low-voltage armature; whereas in the other systems only that portion of the power represented by the generator current has been transformed, the current in the neutral wire being in this case the sum of motor and generator currents. These conditions require a balancer of much smaller size for the same neutral current and the operative efficiency is higher.

In regard to the question of balancer ratings, it seems obvious that the logical rating is one based on the value of the neutral current, i. e., a balancer having a capacity of 50 kw on a 240-volt, three-wire system would provide for a neutral current of 417 amp. at 120 volts. In the arrangement of Fig. 1 each armature must be able to withstand an intake of 50 kw plus the losses of conversion, while in the arrangements shown in the other figures each armature must have a capacity of 25 kw plus the losses of conversion, which in these cases are much smaller.

Omitting Fig. 1 from further consideration, the division of the neutral current between the two armature windings as represented in the other diagrams may be determined as follows:

Let Ig = generator current.
Im = motor current.
In = neutral current.
eg = generator efficiency.
em = motor efficiency:
Then $egem$ = balancer efficiency.

$$Ig = Imemeg. \tag{1}$$

$$In = Im + Ig. \tag{2}$$

$$Im = \frac{In}{1 + emeg}. \tag{3}$$

$$Ig = \frac{Inemeg}{1 + emeg}. \tag{4}$$

Approximations:

Assume $eg = em = e$, the average efficiency.

$$Im = \frac{In}{1 + e^2}. \tag{5}$$

$$Ig = \frac{Ine^2}{1 + e^2}. \tag{6}$$

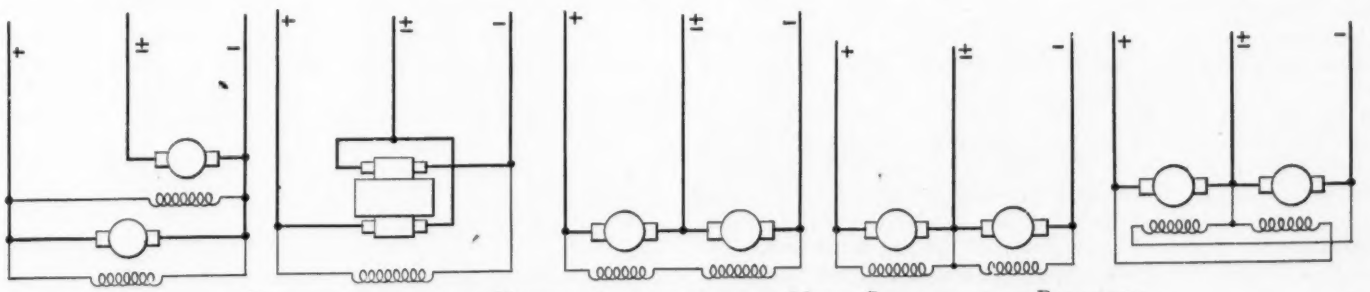
Again:

$$Im = \frac{In}{2e}. \tag{7}$$

$$Ig = \frac{Ine}{2}. \tag{8}$$

Thus there are three methods for determining the division of the neutral current. As to comparative accuracy, equations (3) and (4) may be taken as standard; then, for a balancer set with $eg = 0.7$, $em = 0.6$, $e = 0.65$, equations (5) and (6) give values of Im and Ig, 1.4 per cent and 2 per cent high, respectively, while equations (7) and (8) give values 8.4 per cent and 9.8 per cent high. For $eg = 0.81$, $em = 0.79$, $e = 0.8$, equations (5) and (6) are practically accurate, while (7) and (8) give values 2.5 per cent high. It is thus seen that even for an absurdly small balancer set the various equations are sufficiently close for most purposes.

For more refined caluculation, equations (1) and (2) should be used, the efficiencies em and eg being computed exclusive of the field circuit loss. These equations hold strictly true for the arrangements shown in Figs. 2 and 3, and are practically true for the arrangements of Figs. 4 and 5, where the proportion of the field current derived from the neutral is always negligible. Of course, the field circuit losses should be considered in calculating the balancer efficiency. Other sources of error are in the variation of stray power due to change in speed and to change in flux with load. These may be taken into account when necessary, but such refinement is seldom required.



FIGS. 1, 2, 3, 4 AND 5.—VARIOUS ARRANGEMENTS OF MOTOR-GENERATORS AS BALANCERS.

In the design of a balancer it is probably easier not to calculate the individual efficiencies at all, but to construct a table as follows:

I (armature)						
I^2R (arm. and brushes)						
Fixed losses						
Total losses						
EI						
EI — losses (= mot. output)						
EI + losses (= gen. intake)						

From this table a double set of curves of current against watts may be plotted as in Fig. 6. Motor current is measured to the left of the zero, generator current to the right. Any ordinate value common to these curves represents the motor output and the simultaneous generator intake, and the horizontal distance between the two equal ordinates indicates the current in the neutral wire. In this instance a generator current of 32.5 amp. and a simultaneous motor current of 58.5 amp. combine to make a neutral current of 91 amp. This service would require a balancer rated at 10 kw at 110

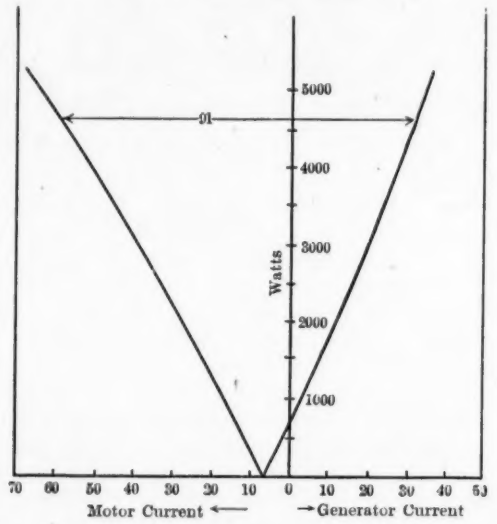


FIG. 6.—CHARACTERISTICS OF MOTOR-GENERATOR BALANCER.

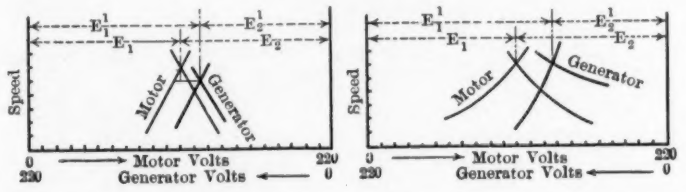
volts, with a combined armature efficiency of 55.6 per cent. The losses in this example were purposely exaggerated in order to show the characteristics of the curves. It will be noticed that each is slightly convex toward the right.

The operation of the balancer is clearly shown. At balanced load the two machines take a motor current of 6.7 amp., representing the stray power of the machines; there is no neutral current. As soon as the load becomes slightly unbalanced, the motor current of one machine decreases and the motor current of the other increases by an equal amount. The neutral current is the difference between the two motor currents. Finally the one machine takes absolutely no current and the other takes twice the no-load value, representing the combined stray power of the two armatures. The neutral wire furnishes this current. With a still greater unbalancing the first machine begins to supply a generator current, deriving its power from the other armature, which acts as a motor, and the current in the neutral wire is the sum of the generator and motor currents of the two armatures.

The inherent regulation of a shunt balancer depends upon the field circuit connections. Three distinct solutions will be given. Figs. 2 and 3 present the same problem, Fig. 4 another and Fig. 5 still another. The method of solution involves the speed-pressure curve of each machine, and a graphical representation with double curves is used.

In the case of Figs. 2 and 3, the method is particularly simple. The left-hand lines on Fig. 7 are the no-load curves plotted between armature pressure and speed. The common base line of these curves represents the total voltage of the system. The curves are symmetrical with respect to a vertical axis through the point of neutral potential, and they intersect on this axis, i. e., the point of common speed occurs at exactly balanced voltage. To ascertain the regulation at a certain load, the division of current is taken from the curves, Fig. 6, and the speed curves are plotted for the respective currents, allowing for the resistance drop in the armature and brushes. The motor curve will be a straight line parallel and to the right of the no-load curve, as shown by the right-hand line, i. e., the motor will require a higher impressed pressure to maintain a certain speed under load than at no load. Similarly the generator will deliver less voltage at a certain load than at no load, and its speed curve will be parallel and to the right of the no-load generator curve. This curve is also shown at the right. The point of intersection of the load curves, the point of common speed, determines the regulation, at the chosen neutral current. The shifting of the neutral potential is clearly shown to be the average of the two armature drops. It is the product of half of the neutral current multiplied by the resistance of the one armature including brushes. The curves are not needed for a practical case, but are given because they illustrate the operation so clearly.

In this, as in the cases that follow, armature reaction has been



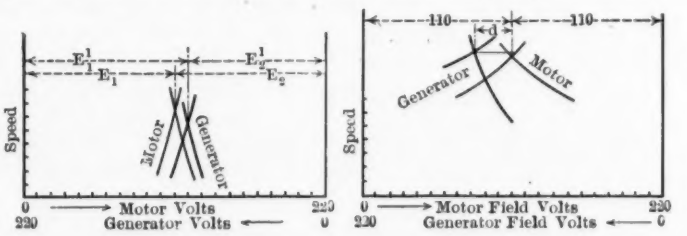
FIGS. 7 AND 8.—CHARACTERISTICS OF MOTOR-GENERATOR BALANCERS.

neglected. The operating position of the brushes is neutral, because either armature must be reversible in its function as generator or motor. Even if the brushes were shifted, the increase in speed of the motor would be almost compensated by the decrease in the voltage of the generator, and the regulation would remain practically undisturbed. For equal brush leads the motor would have a slightly greater armature reaction, but in the dynamotor the regulation would not be affected even with a large excess of motor armature reaction, since both windings are in the same field.

In the arrangement shown in Fig. 4 the regulation is obtained by the same method, but the curves take a different form. Here the junction of the two field windings is connected to the neutral wire and the speed is determined by two varying factors, field flux and armature voltage. Knowing the winding of the machine, the speed

can be expressed by the equation, $V = \frac{e}{\phi} k$, where V = speed, e = internal or generated pressure, ϕ = flux, and k is a constant.

Knowing the saturation curve, several points may be chosen along its working portion and the corresponding speeds calculated. In this manner the no-load and full-load curves (Fig. 8) have been obtained, and the regulation determined as before. The displacement of the potential of the neutral wire is greater than in the previous case, because the motor field is strengthened by the unbalanced load and the generator field weakened, i. e., the motor re-



FIGS. 9 AND 10.—CHARACTERISTICS OF MOTOR-GENERATOR BALANCERS.

quires a greater voltage to make the common speed and the generator gives a lesser voltage at the common speed. The moral is that connecting the neutral wire to the "straight" field coils is damaging to regulation.

The regulation with crossed field coils, Fig. 5, is ascertained in the same way; but it must be remembered in deriving the curves that the impressed pressure assumed for the armature of one machine is the field pressure on the other machine. Expressing this fact in another way, for a given voltage on the armature of a machine the field voltage of this same machine is equal to the total line voltage minus the given voltage. It is convenient in this and in the other cases to plot the saturation curve in terms of flux and pressure across the field coil. From the speed curves, Fig. 9, may be determined the regulation, which is better in this than in any of the previous cases. This result may be attributed to the fact that the

motor field is weakened and the field of the generator strengthened by an unbalanced load; i. e., the motor requires a lesser voltage to make the common speed, and the generator gives a greater voltage at the common speed. This is the method by which a shunt balancer should be connected.

Whether the shunt field coils are connected according to diagrams 3, 4 or 5, the series ampere turns for level compounding will be the same, because the shunt field coils will in all cases be subjected to the same voltage. The speed curves, Fig. 10, are plotted against field circuit pressure, the armature pressures being assumed constant and balanced. The shifting of the intercept of the two curves from no load to full load, represented by the distance d is the average of the voltage by which the e.m.f. of the field circuit of the motor should be decreased and that of the field circuit of the generator increased in order to balance the system. Knowing the resistance and the number of turns of the field winding, the distance d can be translated into ampere-turns, from which may be ascertained the number of series-turns for level compounding.

For over compounding, as in the case of a heavy neutral drop, the same methods can be used. The connection of the shunt field is a factor in determining the result. The problem is of little more than academic importance and will not be pursued.

In applying these methods for determining the regulation or the compounding, it is not necessary to compute the no-load curves, as their intercept always falls on the axis of neutral potential.

Industrial machines give better regulation than indicated in the examples given, the losses having been, in this instance, purposely exaggerated to amplify characteristics.

The Practical Application of the Heyland Diagram for Induction Motors.

BY W. C. WAY.

FEW diagrams are so complete in every detail as the Heyland diagram; in fact, there is very little information relating to the performance of an induction motor which it does not give when fully developed. The Heyland or "circle diagram," as it was originally called, is simple in practical construction and accurate in its results. The induction motor has a definite set of characteristics. A definite current gives a definite torque at a definite speed. This fact makes it possible to construct curves, such that a definite point on the one corresponds to definite points on the others.

In dealing with the induction motor it is necessary to recognize two different frequencies, one for the primary and one for the

FIG. 1.—MAGNETIC FLUXES IN AN INDUCTION MOTOR.

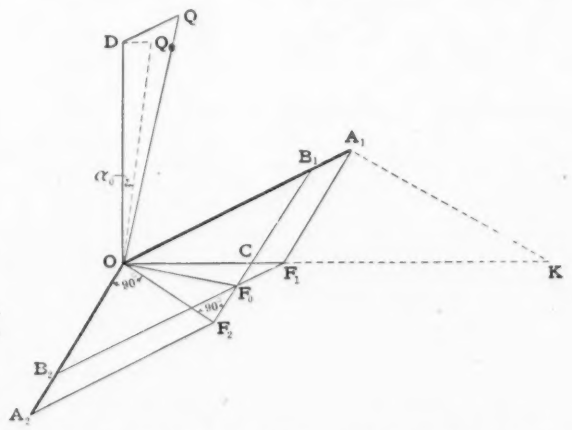


FIG. 2.—RELATION OF MAGNETOMOTIVE FORCES IN AN INDUCTION MOTOR.

secondary circuit. Let n_1 cycles per second be the frequency of the current in the primary circuit and n_2 cycles that in the secondary, then $n_1 - n_2 = s$ is the slip, and it indicates the rate at which the secondary winding is cut by the primary lines of force. The e.m.f. thus generated produces a secondary current with its accompanying flux, which revolves with a speed s relative to the rotor. Since this speed is in the same direction as the mechanical rotation, the absolute speed of the flux is $n_2 + s = n_1$, or the same as that of the primary flux.

Fig. 1 represents two wires, A and B, of an induction motor directly opposite and separated by an air-gap, the wires being practically surrounded by iron. Now if a current is passed through the wire, A, lines of force are set up which encircle both A and B. These lines induce a secondary e.m.f. in B and the secondary current produced sends lines in the opposite direction, which encircle both wires. There is also a leakage flux around each separate wire, the flux produced by the secondary current being opposite to that in the primary circuit. Of course, neither the primary nor the secondary flux really exists separately, but the resultant of these two is real. It is more convenient, however, to consider them separately. The magnetic flux in the primary differs from that in the air-gap flux by the primary leakage flux. Such is also true of the secondary flux.

Let the example now be extended to the whole of the winding, taking the flux proportional to the ampere-turns. In Fig. 2 $O A_1$ is drawn proportional to the primary ampere-turns, with the primary current at some definite phase lag ϕ, and $O A_2$ is drawn to repre-

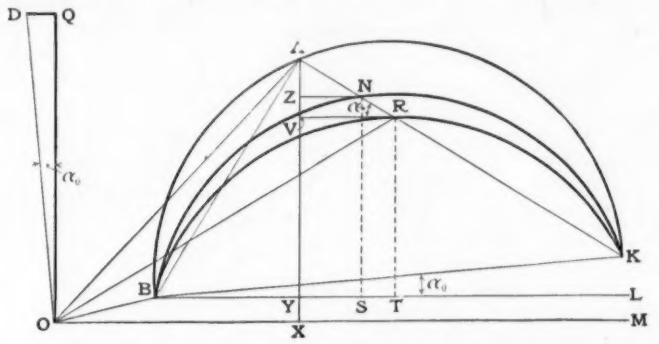


FIG. 3.—IDEAL CIRCLE DIAGRAM OF AN INDUCTION MOTOR.

sent the ampere-turns of the secondary. The primary and secondary fluxes are also proportional to these lines. The leakage flux in the primary is represented by A_1B_1, and that in the secondary by A_2B_2. The ratio of A_1B_1 to $O B_1$ is constant, and also the ratio of A_2B_2 to $O B_2$ is constant. The actual flux in the primary iron is the resultant of $O B_2$ and $O A_1$, or is represented by $O F_1$. Similarly in the secondary iron the resultant flux is $O F_2$. The flux in the air-gap is the resultant of $O B_1$ and $O B_2$, represented by $O F_0$. The e.m.f. which would produce the flux $O F_1$ in the primary would be 90° ahead, and so is represented by $O D$. To this e.m.f. is added the primary ohmic drop, I_0R_1 parallel to the magnetizing current. Thus is obtained $O Q_0$, which equals the impressed e.m.f. at no load. $D Q_0$ is taken perpendicular to $O D$, since the leakage current is nearly at right angles to the effective e.m.f, $O D$. A_1K is drawn parallel to $O F_2$, meeting $O F_1$ produced at K. The triangles $O F_2C$ and A_1F_1K being similar, the angle F_1A_1K equals the angle $O F_2C$, which equals 90°, since for any value of the primary current the angle $O F_2C$ is always equal to $A_2O F_2$, which has been shown to be equal to 90°. Now if F_1K is constant and not dependent on the value of the primary current, A_1 will travel in a semi-circle. This relation can be proved as follows:

$O B_1/O A_1 =$ a constant $= n_1$; also $O B_2/O A_2 = n_2$, since the ratio of the leakage flux to the total flux may be taken as constant.

$$\frac{K F_1}{O C} = \frac{A_1F_1}{C F_2} = \frac{A_1F_1}{B_1F_2 - B_1C} = \frac{O B_2}{B_1F_1} - B_1C = n_2 \times \frac{O A_2}{B_1F_2} - B_1C$$

$$O C = \frac{O B_1}{O A_1} \times O F_1 = n_1 \times O F_1;$$

$$B_1F_1 = O A_2,$$

$$B_1C = n_1 \times A_1F_1 = n_1n_2 \times O A_2.$$

Substituting $K F_1 = \dfrac{O F_1 \times n_1n_2}{1 - n_1n_2}$, which is constant, since $O F_1$ is assumed constant.

The angle $D O A_1$ measures the angle of lag for the value of current corresponding to $O A_1$, and as this angle varies A_1 travels in a semi-circle, with F_1K as the base. The value of the primary current varies from $O F_1$ at synchronism to $O K$ at standstill.

In the above proof the resistance of the winding and the exciting current have been neglected. Now considering these, $O Q_0$ will be

the e.m.f. applied to the primary circuit at synchronism, or no load. It is convenient in making the diagram to have $O\,Q_0$ vertical; therefore, in Fig. 3 the diagram is revolved through the angle $D\,OQ_0$, equal α_0. $O\,B$ is then drawn equal to the no-load exciting current with the proper power factor. $B\,L$ is drawn horizontal from B and the angle $K\,B\,L$ is made equal the angle α_0, and the semi-circle is described as in the previous figure.

The primary current at a certain load represented by the point A will have two components: $B\,A$, the useful component, and $O\,B$, the no-load exciting component, the latter including the effect of the iron loss, friction and windage, the exciting current being assumed to remain constant. The distance $A\,R$ is made proportional to $A\,B$, the useful component of the primary current. $A\,X$ is drawn perpendicular to $O\,M$, and $V\,R$ perpendicular to $A\,X$. The line $B\,R$ is then drawn. Now $A\,R$ is equal to $k \times A\,B$ (k being a constant).

$$\frac{A\,R}{A\,B} = cot\ A\,R\,B = \frac{k\,A\,B}{A\,B} = k;$$ that is, the angle $A\,R\,B$ is constant; therefore, the angle $B\,R\,K$ must be constant, not depending upon the value of the primary current, i. e., R always lies on the arc of a circle drawn through the three points $B\,R\,K$. $A\,V = A\,R\ sin\ \alpha$, but $A\,R$ varies as I (I being the useful component of the primary current). $Sin\ \alpha$ varies as I; therefore, $A\,V$ varies as I^2.

If $A\,R$ is taken to the proper scale, $A\,V$ measures the watts lost in resistance. $A\,X$ measures the input to the same scale, $X\,Y$ the iron loss and $R\,T$ the output. If $A\,R$ is divided in the ratio of primary to secondary resistance, a point, N, is found. Since this ratio is constant, N lies on the arc of a circle. The line $N\,Z$ is drawn perpendicular to $A\,X$, then $Z\,V$ represents the loss due to secondary resistance, and $N\,S$ equals the synchronous watts and therefore the torque to proper scale. The torque in pound-feet is found by

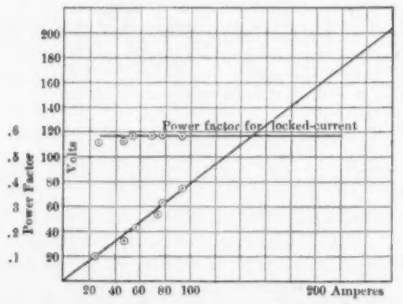


FIG. 4.—STARTING CURRENT OF 10-HP, TWO-PHASE INDUCTION MOTOR.

dividing the synchronous watts by the synchronous speed in r.p.m. and multiplying the result by the constant, 7.04.

PRACTICAL APPLICATION.

In the test which is outlined below the machine used was a two-phase induction motor designed for 10 hp at 200 volts, full-load speed 850 r.p.m. The readings taken may be seen from Tables 1 and 2. The method employed for taking speed, by speed indicator, was not perfectly accurate, but the results obtained were sufficiently exact to show how well the points plotted from the readings fell upon the curves of input, synchronous watts and output, thus proving the theory employed.

At the beginning of the test readings were taken to determine the locked current, i. e., with the rotor at rest. Table 1 gives the readings obtained and these are plotted in Fig. 4. By drawing a straight line through the points obtained, the current corresponding to normal voltage was found to be 256 amp. At the lower voltages the points lie below the straight line. This is on account of the change of primary resistance due to heating and also to the inductance being proportionally greater to the current before saturation than after. On the same diagram the power factors for different values of locked current are plotted, showing the power factor to be practically constant. The value at normal voltage is obtained by taking an average. The resistances of both phases of the primary circuit were also observed after having run the machine long enough to heat the winding. For readings in Table 2 the motor was loaded by

TABLE 1.

Phase (A) Volts.	Phase (A) Amperes.	Phase (A) Kilowatts.	Phase (B) Volts.	Phase (B) Amperes.	Phase (B) Kilowatts.	Power Factor.
21.0	13.75	0.16	20.5	13.60	0.16	0.566
33.5	22.60	0.43	33.5	22.40	0.43	0.572
43.5	29.13	0.73	42.5	28.75	0.72	0.584
55.0	37.20	1.20	55.0	37.70	1.20	0.584
62.5	39.25	1.43	63.0	39.30	1.47	0.588
75.1	47.50	2.06	73.5	47.20	2.05	0.585

TABLE 2.

Phase (A) Volts.	Phase (A) Amperes.	Phase (A) Kilowatts.	Phase (B) Volts.	Phase (B) Amperes.	Phase (B) Kilowatts.	Speed of motor = n_1.	Synch. speed = n.	Lbs.	Power factor.	Output K.W.	Input K.W.	Synch. kilowatts.
200.	7.1	0.12	199.0	6.7	0.22	894	906	0.0	0.123	0.0	0.34	0.00
200.6	8.2	0.88	199.5	8.0	0.96	898	908	4.4	0.568	1.4	1.84	1.41
201.0	10.4	1.50	197.5	10.5	1.64	884	902	8.4	0.754	2.64	3.14	2.70
201.0	13.0	2.18	200.0	13.2	2.28	876	896	12.4	0.850	3.86	4.46	3.95
201.5	16.2	2.80	200.5	16.7	3.00	886	908	16.4	0.878	5.16	5.80	5.28
199.0	19.8	3.50	198.8	20.3	3.80	862	896	20.4	0.915	6.24	7.30	6.50
202.0	23.8	4.50	205.0	24.5	4.56	876	912	24.4	0.925	7.60	9.06	7.91
					No-load current							
201.0	7.45	0.05	202.0	7.42	0.06							

means of a mechanical brake with a 2.5-ft. lever. The power factors were calculated for different sets of readings of Table 2. These values are plotted as in Fig. 5. The line $a\,b$ shows the no-load current with proper power factor. A horizontal line, $b\,t$, is drawn from

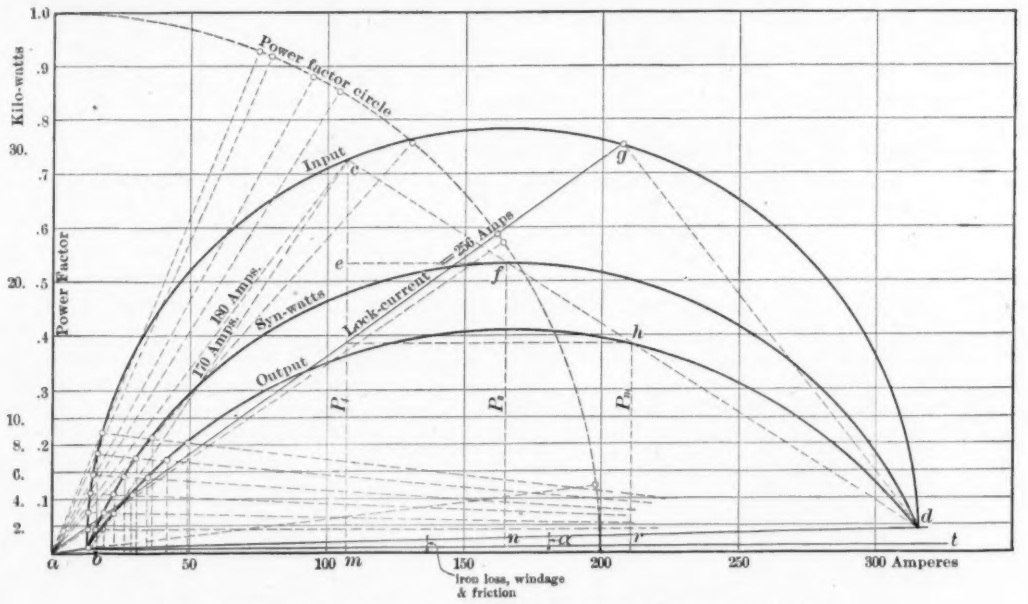


FIG. 5.—CIRCLE DIAGRAM FOR 10-HP, 200-VOLT INDUCTION MOTOR.

b, the angle α_0 is calculated from the relation $tan\ \alpha_0 = \frac{I_0 R_1}{E}$, I_0 equals the no-load current, R_1 equals the primary resistance, and E equals the primary voltage. A line is then drawn from b making the angle α_0 with $b\,t$. This line is the base of the semi-circle. The locked current at normal voltage is plotted with power factor 0.574 previously obtained. Having two points and the position of the base the semi-circle of input can be described.

Taking any convenient value of the primary current, as for example 180 amp., chosen in plotting these results, the line $a\,c$ is so drawn that it has the proper value of 180 amp. to scale. The line $c\,m$ is drawn perpendicular to $b\,t$. Along $c\,m$ is measured the value of $I_1^2 R_1 = 7.67$ kw, which is plotted as $c\,e$. The horizontal line, $e\,f$, meets, $c\,d$ at f, the circle for synchronous watts passes through this point. The two other points, b and d, having previously been obtained, this segment can be drawn. Another arc of a circle is drawn tangent to $g\,d$ and passing through b and d. This is the circle of output. From f and h perpendiculars are drawn to the line $b\,t$.

Synchronous watts for 180 amp. is $f\,n = P\,s$, from which the torque can be obtained. Output is $h\,r = P_m$.

$$\frac{actual\ speed}{synchronous\ speed} = \frac{P_m}{P_s}.$$

$$\text{Slip} = (P_s - P_m)\ /P_s.$$

The actual efficiency is P_m/P_1. The points on the left of the diagram which are encircled were plotted from experimental data, and

from these it can be seen how nearly they fall on the circles drawn in accordance with theory.

$$Tan\ a_0 = \frac{I_0 R_1}{E} = 0.0198.$$

$$\text{Output in kilowatts} = \frac{0.746 \times T \times 2\pi \times n_1}{550 \times 60} = X.$$

$$\text{Synchronous watts} = \frac{X \times n}{n_1}.$$

(n = synchronous speed, n_1 = speed of motor.)

$$\text{Resistance of stator winding per phase} = \frac{12}{22.6} = 0.532.$$

Core Losses in Induction Motors.

BY R. E. HELLMUND.

IN testing induction motors it is difficult to determine the true core losses for the loaded motor. It is, therefore, customary to test the core losses at no load, and to assume that the losses for the loaded motor are the same. This of course is only approximately true.

For motors with phase-wound secondaries, the following method gives more correct values: In addition to the usual tests necessary for drawing the circle diagram of the motor, the following tests are required: First, the no-load losses and currents are ascertained for different potentials as is usually done, in order to determine the

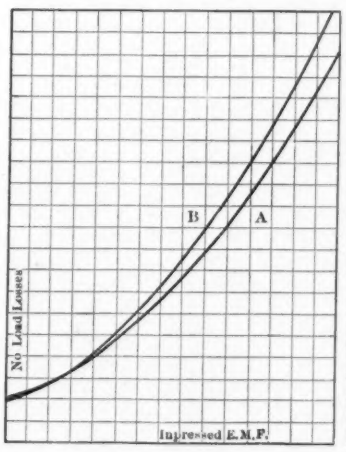


FIG. 1.—RELATION OF NO-LOAD LOSSES TO IMPRESSED E.M.F.

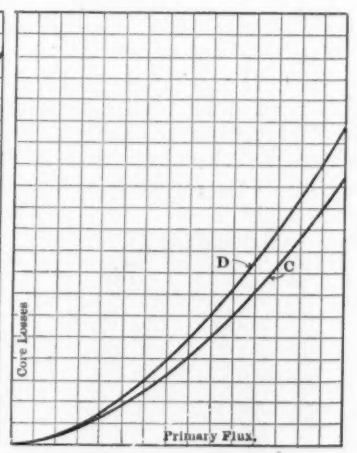


FIG. 2.—RELATION OF CORE LOSS TO PRIMARY FLUX.

no-load core losses (curve A in Fig. 1). Second, a high resistance is connected in each phase of the secondary circuit, and always so regulated that the rotor slip is as high as it is for the load for which the iron losses are to be determined. Under this latter condition the no-load losses and currents are again observed for different potentials (curve B in Fig. 1).

By deducting from the no-load losses the I^2R and friction losses, which are both easily determined, the pure core losses for both cases are easily derived. They are given in Fig. 2 by the curves C and D,

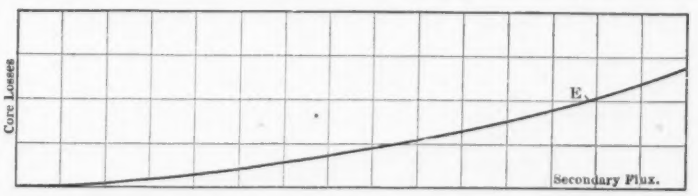


FIG. 3.—RELATION OF SECONDARY CORE LOSS TO SECONDARY FLUX.

orresponding to A and B, respectively; instead of the impressed e.m.f. the corresponding primary field flux is introduced on the lower scale of this figure.

The differences between the values of curve C and D are given in curve E of Fig. 3. On the lower scale of this figure, however, instead of the primary field there is used the corresponding secondary field, which may be easily determined from the circle diagram.

Now curve C of Fig. 2 shows for all different field values the core losses which are caused by the high-frequency or primary flux, and curve E of Fig. 3 shows the core losses which are caused for a certain slip by the low-frequency or secondary flux. The changes of the fluxes from the tested no-load condition as given above to the condition for the loaded motor are as follows:

First, The primary flux diminishes on account of the primary drop of potential caused by the ohmic resistance. The actual value of the primary flux at load is given, however, in the circle diagram and the corresponding core losses may be found from curve C.

Second, the secondary flux diminishes on account of the primary ohmic drop and the secondary reaction. The actual value of the secondary flux is also given by the circle diagram and the corresponding core losses may be found from curve E.

Third, the leakage flux increases.

The greater part of this flux, however, goes through air, and, therefore, does not cause any core losses. Only a small part of the leakage flux, the zig-zag leakage, goes through a small part of the top of those teeth which are at a pole limit. The core losses thereby caused are very small, since the flux as well as the amount of iron, through which it passes, are very small. The change of the core losses caused by the change of the leakage flux may, therefore, be neglected.

Thus, the total core losses for the loaded motor are equal to the sum of the values obtained from curves C and E as described above.

Test of a Valve Magnet.

BY C. P. NACHOD.

Apropos of Mr. C. R. Underhill's interesting and valuable papers on electromagnets is the following test on a magnet, as showing

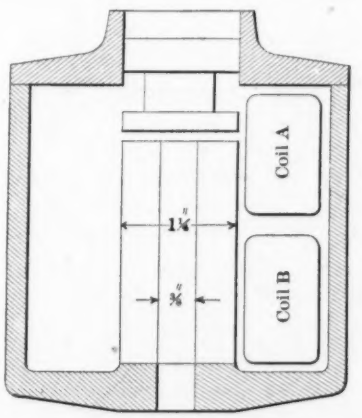


FIG. 1.—VALVE MAGNET.

the effect which the position of the magnetizing coil with respect to the working air-gap has on the pull produced.

This magnet, shown in Fig. 1, has a short stroke, and is designed to operate an air-valve by means of a brass rod (not shown) passing through the hole in the core. The core and armature are of Norway iron; the core has an outside diameter of 1¼ in. and has a ⅜-in. hole through it. The magnet is of the iron-clad type with cast-iron shell and top. There is a cylindrical clearance gap between the armature and top, which, being invariable, has not been considered.

There are two exciting coils, A and B. The former, having 1,860 turns of No. 25 wire is used as an operating coil to draw down the armature; and the latter, of 1,765 turns of No. 26 wire, serves as a retaining coil to hold it down against the air-pressure, after the circuit in the other coil is broken. Coil A, as shown in Fig. 1, is located so as to encircle the working gap, which is not the case with B.

The test was made with a simple traction permeameter, definite air-gaps being obtained by measured brass washers.

Fig. 2 shows the pull produced with varying excitation for each coil separately, with a constant air-gap of .0162 in. In the curve for coil A the range of magnetic densities is sufficient to show clearly the change in permeability of the iron circuit. For so small an

air-gap, the difference between the pulls produced by the two coils with the same magnetizing force is remarkably great. The ratio of these pulls has been plotted, and the curve shows that coil *B* is only from .4 to .8 as effective as *A*, due solely to its position on the core, which permits a larger magnetic leakage. This ratio curve has a peculiar feature, in that it approaches unity as the flux-density

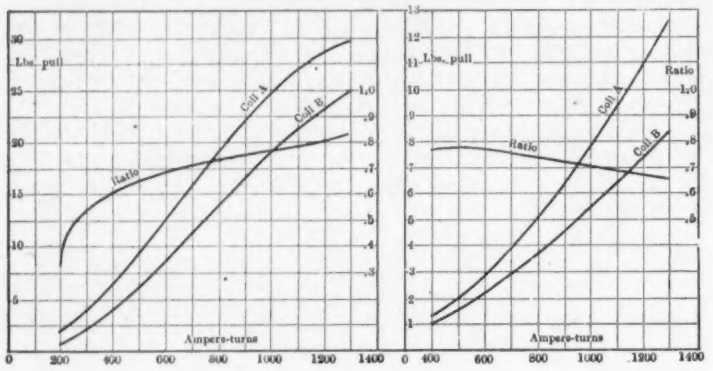


FIG. 2.—PULL WITH .0162 IN. GAP.

FIG. 3.—PULL WITH .081 IN. GAP.

is increased, as though the leakage were less at higher densities—a phenomenon not easily explained.

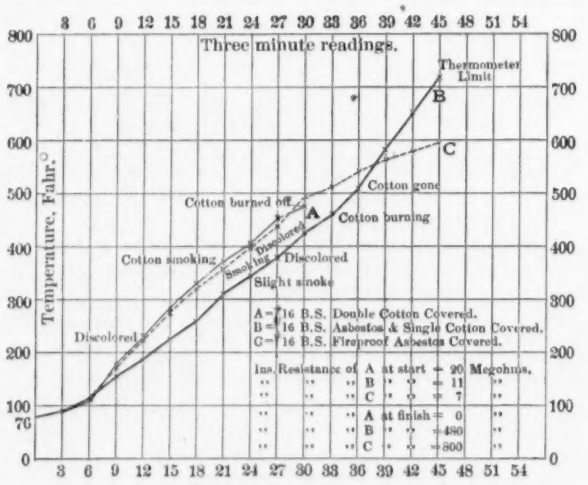
Fig. 3 shows the same relations with an air-gap of .081 in. or five times as great as in the previous case. With this gap the range of flux density is not great enough to produce an inflection point in either curve; and the ratio of pulls for the same excitation is more nearly constant, averaging a little over .7, but decreasing with increasing density.

From the curves it appears that, if it were desired to connect the coils in series so that the magnetic effect of *B* would neutralize that of *A*, it would be possible to do so for only one, instead of all current values, and that such a neutralizing coil for all current values should have the same axial length and slide within or without the other.

Tests of Magnet Wire.

By C. H. BARRETT.

The tests of magnet wire described below were undertaken as a result of considerable trouble from the field coils of motors breaking down, due to exposure to high temperatures. The motors were


Three minute readings.
Thermometer Limit
Temperature, Fahr.°
Cotton burned off
Cotton gone
Cotton burning
Cotton smoking
Smoking
Discolored
Slight smoke
Discolored
A = 16 B.S. Double Cotton Covered.
B = 16 B.S. Asbestos & Single Cotton Covered.
C = 16 B.S. Fireproof Asbestos Covered.
Ins. Resistance of A at start = 20 Megohms.
" " " B " " = 11 "
" " " C " " = 7 "
" " " A at finish = 0 "
" " " B " " = 480 "
" " " C " " = 800 "

TEST OF MAGNET WIRE.

mostly on furnace cranes handling molten metal, and the temperature of the cases frequently reached 360° to 400° F.

Curve A shows the results of a test on No. 16 B. & S. double-cotton covered magnet wire of .060 in outside diameter. The covering at 280° F. showed discoloration; at 370° the covering was smoking badly, and at 472° wire was completely bare. This wire showed the highest insulation resistance at the start, but fell down after passing 370°.

Curve B refers to a test on No. 16 B. & S. asbestos and single cotton-covered wire. At 340° a slight smoke showed up; at 372° discoloration of cotton took place; at 460° the cotton burned, and at 506° cotton was gone. From 506° up to 720°, which was the limit of the thermometer in use, the asbestos held good and showed an insulation resistance of 480 megohms at close, against 11 megohms at start. The asbestos, however, would not stand very rough handling, though considering the temperature it was in pretty fair shape. The outside diameter over insulation of this wire was .068 in.

In curve C are plotted the data of a test on No. 16 B. & S. fireproof wire which withstood the high temperature excellently except for a slight discoloration, and was in good shape at the finish. Its insulation resistance at start was lower than any, but at the finish reached as high as 800 megohms.

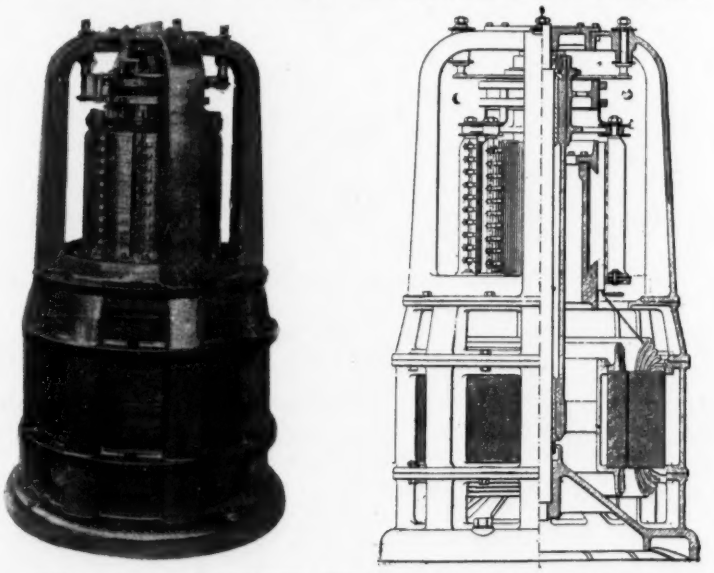
After making the tests it was decided to use the asbestos and cotton-covered wire and motor troubles were practically ended. Coils have been opened up with every vestige of cotton gone, yet the asbestos kept the insulation almost perfect. It was found necessary to insulate only the top, bottom and inside of coils heavily, leaving the outside with just a covering of cotton tape, thus assisting radiation of the heat. The reason the fire-proof wire was not used was on account of its affinity for moisture due, undoubtedly, to the large amount of silicate of soda used in the composition of its covering. In very damp weather the insulation resistance would fall very low on this wire.

The wire in each case was wound on bare sheet-iron spools, then joined in series and a current of 22 amp. passed through them. A thermometer was placed in each coil and the temperature taken every three minutes. The resistance was taken with Wheatstone bridge. The thermometers were carefully selected for accurate reading.

An Alternating Current Rectifier.

On page 827 of our issue for November 11 was given a short description of the "permutator," of the Société Anonyme Egyptienne d'Electricite, in service at the Liege Exposition. We are able to give below a more complete account of the machine.

The input side of the machine is similar to the stationary primary winding of a polyphase induction motor, while the winding of the output side, which is arranged adjacent to the primary, is connected to a commutator similar to that of an armature of a direct-current generator. These two windings of the machine are stationary. The current in the polyphase primary winding produces a revolving field



FIGS. 1 AND 2.—PERSPECTIVE VIEW AND SECTIONAL ELEVATION OF CONVERTER.

which penetrates into the secondary armature winding. This field generates a counter e.m.f. balancing the primary voltage, and it generates in the stationary armature conductors an alternating e.m.f. which bears to the primary e.m.f. the effective ratio of the turns of the corresponding windings. By means of brushes on the commutator which rotate synchronously with the revolving field a unidirectional e.m.f. is obtained from the stationary armature.

As seen from Figs. 1 and 2, the general appearance of the permutator is quite similar to that of a Curtis turbine. It is provided with a stationary magnetic circuit in the lower part of the structure. The commutator, shown near the top, is also stationary. The

brushes, however, revolve, the two slip rings serving as a path for the unidirectional current from the armature.

The brush rigging is driven synchronously by means of a derivation of the main flux from the primary, and not by a separate motor as might be assumed. Fig. 3 indicates the magnetic circuits of the machine and shows the circular electromagnet to which the brush rigging is directly attached. It is evident that this movable concentric iron mass with its winding may be caused to operate in all respects similarly to the rotary secondary of an induction motor.

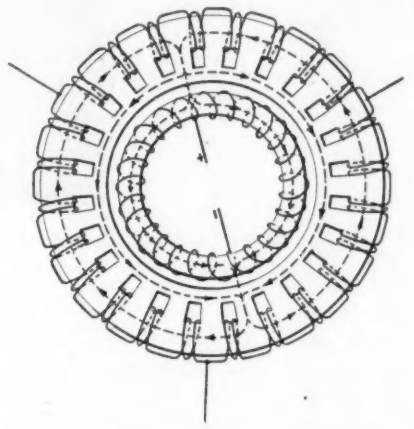


FIG. 3.—DIAGRAM OF ELECTRIC AND MAGNETIC CIRCUITS IN A PERMUTATOR.

The induction motor action is employed in accelerating the brush rigging from standstill, but during normal operation the wiring of the electromagnet is fed with direct current from the machine itself, and, therefore, this secondary winding revolves synchronously without slip.

An advantageous feature of the machine resides in the fact that the small mass of the revolving parts can rapidly be accelerated to full speed, and the time consumed in synchronizing the machine is inappreciable in comparison with that necessary with a rotary converter. The starting and speeding up of the machine present no more complication than is the case with a regular induction motor. The direct current in the movable secondary winding not only causes the brushes to revolve synchronously, but it serves to supply the exciting current to the machine, which on its input side, therefore, operates similarly to a synchronous motor. Thus the machine starts as an induction motor having a rotor of minimum inertia and assumes the characteristics of a rotary converter after having been synchronized. The ratio between the alternating and direct voltage can be placed at any value desired. The primary can be wound directly for the line voltage, thus dispensing with the use of stationary transformers.

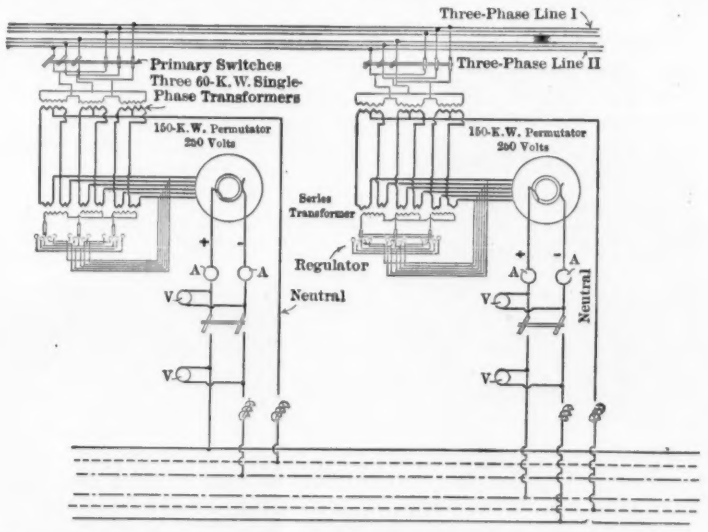


FIG. 4.—DIAGRAM OF CIRCUITS FOR TWO PERMUTATORS, THE TRANSFORMERS AND THEIR REGULATORS.

At the Liege Exposition three of the permutators have been in service. Each is a 150-kw machine in which 50-cycle, three-phase current at 3,000 volts is transformed into direct current at 250 volts, and this voltage is subdivided into 2 × 125 by the use of a neutral wire tapped from the secondaries of step-down transformers, as shown in Fig. 4. Two machines can be operated separately for feeding a three-wire, direct-current system, or two machines can be connected in series and feed a five-wire, 4 × 125-volt system, the third machine being held as a reserve.

Each permutator is provided with three single-phase transformers for decreasing the primary pressure from 3,000 to about 200 volts, the secondaries being connected in "double-star," six-phase for feeding the permutator. A single set of polyphase closed-coil windings in each machine serves as both the input side and output side of the permutator, the six leads to the secondaries of the transformers and the numerous leads to the stationary commutator being joined to this one set of coils, so that the neutral point of the transformers is simultaneously the neutral point of the direct-current system.

A diagram of the circuits of two permutators arranged for operation either in parallel or in series is shown in Fig. 4. In the secondary circuits of each machine there are placed series transformers which allow a possible variation of the direct e.m.f. from 230 to 270 volts. The regulation of voltage is obtained as follows: The three auxiliaries have their secondary windings in series with the alternating-current circuits of the permutator, their primary windings being connected to a three-pole commutating switch. When this switch is in its middle position, the primary windings of the auxiliary transformers are short-circuited, and the machine operates as though it were connected directly to the main transformers. When the switch is in its other positions the primary winding of each phase is connected to one or the other pole of the secondary corresponding to that phase or to one of the other phases, which adds in series or in opposition a voltage of a corresponding phase or +60 or —60°

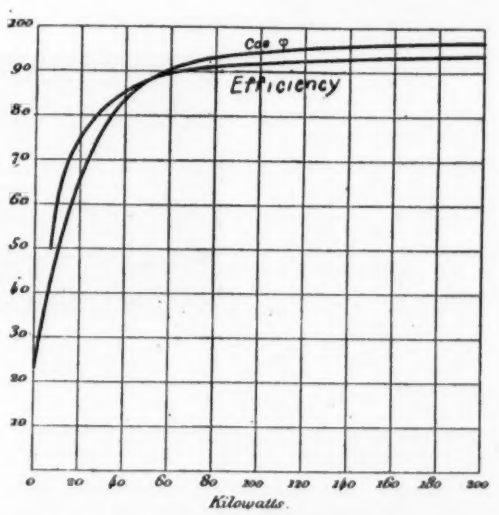


FIG. 5.—PERFORMANCE OF 150-KW PERMUTATOR.

apart, with the result that the five positions give the variations noted above.

The performance of a 150-kw permutator is shown in Fig. 5. Experiments have shown that the permutators can be synchronized in about three seconds. The rapid acceleration and synchronization is due to the small inertia of the revolving parts, and to the strong synchronizing currents produced in the brush rotating winding. The currents in the rotor at starting are not considered as dangerous as are the currents in the field windings of a rotary converter. The starting current, with the load circuit open, has been observed to be about 75 per cent of the full-load current.

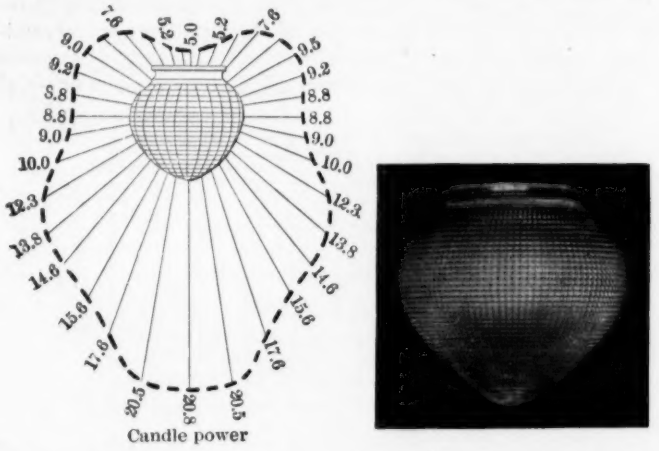
It is evident that when the rotor is brought up nearly to synchronism as the secondary circuit of an induction motor, and then synchronized by means of current from the revolving brushes, the machine may assume a polarity opposite to that desired. The polarity can easily be reversed, however, by simply opening and closing the switches and allowing the machine to slip one pole. The inconvenience of such interruptions and re-establishments of the current is not noticeable at the machine or at the alternator supplying current to the machine, even when the comparative capacity of the generator is small as is the case at the Liege Exposition. If the permutator in service should fall out of step there would be no injurious effect on the remainder of the installation. As a matter of fact, however, the synchronizing power of the machine is so great that there is no danger of its dropping out of step even when working under heavy loads of irregular character.

Reflectors, Shades and Globes.—V.

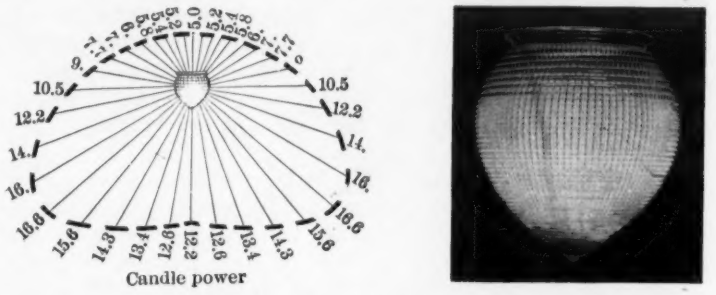
BY J. R. CRAVATH AND V. R. LANSINGH.

THE globes known as "Holophane" are designed with two objects in view. One of these objects is to redirect rays of light, thus accomplishing some of the things accomplished by a reflector in taking light which would otherwise be useless and directing it in useful directions. This redirecting of the light rays as they pass through the "Holophane" globe is accomplished by reflection and refraction of the rays by means of prisms pressed on the outer surface of the globe. The other object accomplished by this type of globe is the diffusion of light to avoid the glare of the arc, incandescent filament, Nernst glower, or gas flame, as the case may be. That is, it accomplishes the same thing as the frosted bulb or globe, only to a much greater degree. The rays of light are broken up by prisms on the inside of the globe so that the eye does not meet the direct light from the filament of the lamp. The rays are so successfully broken by passing through these inner prisms that the whole globe appears to glow with a mild light. The light, therefore, instead of coming from a small, intensely lighted filament, comes from the whole surface of the globe. This reduces materially the blinding effect which has been spoken of frequently before, and enables a person to see better because the pupil or iris of the eye is not contracted to such an extent in an involuntary effort to shut out the intense blinding light. The absorption or loss of light in passing through "Holophane" globes is remarkably low considering what they accomplish. Probably the most extensive tests ever made on this glassware were conducted by Professor W. L. Smith of the Massachusetts Institute of Technology, who found that the loss of light by absorption in this type of globe amounted to from 10.0 to 16.8 per cent, with an average of 12.3 per cent. On account of the deep corrugations which form the prisms on these globes, unnoticed dirt is likely to collect on them and they should be brushed off at frequent intervals with a dry, stiff brush, brushing lengthwise of the prisms. At longer intervals they should be taken down and scrubbed with a brush in soap and water. Like all other enclosed globes, the opening around the shade holder should be filled with a mica or asbestos gasket to keep out dirt. The amount of light likely to be absorbed by the collection of dust on the prisms is not as great as might be anticipated, amounting in one test made at the Electrical Testing Laboratories with a "Holophane" globe thickly coated with dust to about 13 per cent.*

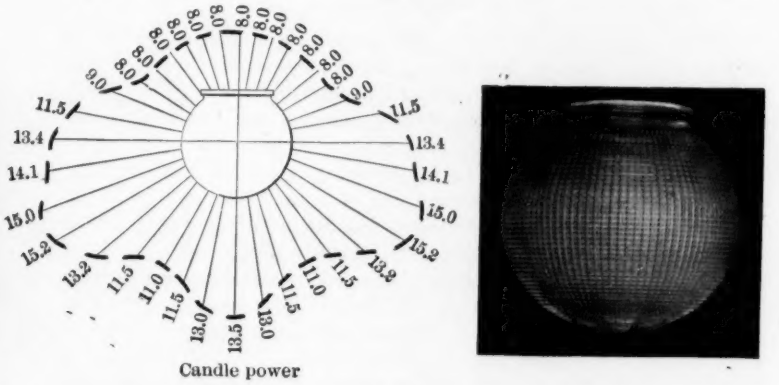
Fig. 28 shows the distribution of light about a 16-cp incandescent lamp enclosed in a "Holophane" globe shown in Fig. 28A. As seen from the test, this globe is one designed to direct the rays of light so as to give a maximum candle power immediately under the lamp. For a distance of 10 degrees each side of the vertical, the candle power is over 20. This is, of course, much less than is obtained with most types of reflectors, and for this reason a globe of this pattern is not to be recommended, unless for artistic reasons where a large amount of downward light is wanted and a diffusing globe is not necessary. There are many locations, however, where it is necessary to use a diffusing globe in order to avoid the glare of the bare lamp filament, and at the same time to direct the light in downward directions. The principal application of this globe is on chandeliers for the general lighting of rooms where the sockets on the chandeliers are placed at an angle of 45 degrees, as is very common. On such a chandelier, this globe will throw the light down into the various parts of the room instead of letting it escape toward the ceiling, and it will, at the same time, do away entirely with the glare from bare lamp filaments. Were reflectors of any kind used for this same purpose, frosted bulb lamps would be necessary and the diffusion or softening of the light could not be as well accomplished as with the "Holophane" globe. This type of globe, which is designed to give a concentrated downward light, should not be used on a chandelier having the sockets pointed straight down if the general lighting of the room is the thing desired; but if it is desired to create a light space for reading immediately under the chandelier and at the same time obtain a fairly good light in other parts of the room, use of these globes on downward pointed sockets will give good results.



FIGS. 28 AND 28A.—DISTRIBUTION OF LIGHT FROM "HOLOPHANE" GLOBE.

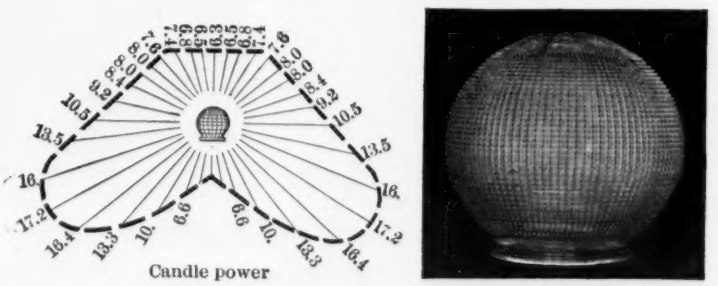


FIGS. 29 AND 29A.—DISTRIBUTION OF LIGHT FROM "HOLOPHANE" GLOBE.



FIGS. 30 AND 30A.—DISTRIBUTION OF LIGHT FROM SPHERICAL PENDANT "HOLOPHANE" GLOBE.

Fig. 29 gives the distribution of light about a 16-cp incandescent lamp enclosed in a "Holophane" globe the general shape of which is the same as that shown in Fig. 28A, the only difference being in the angles of the prisms and the size. This is the smaller of the two globes. This type is designed to distribute light in all directions below the horizontal, giving a good general illumination of a room when they are placed in the pendant position.



FIGS. 31 AND 31A.—DISTRIBUTION OF LIGHT FROM UPRIGHT SPHERICAL "HOLOPHANE" GLOBE.

Fig. 30 shows the distribution of light about a 16-cp incandescent lamp enclosed in a spherical pendant "Holophane" globe, 5½ in. in diameter, shown in Fig. 30A. In this case the light below the horizontal is not greatly increased as compared to the bare lamp except immediately below the lamp. Aside from this increase in candle power immediately below the lamp, the principal effect of this particular globe is to diffuse and soften the light. It can be

* "Aborption of Light by Dust," by V. R. Lansingh. *Electrical World and Engineer*, Oct. 7, 1905.

compared to the distribution of light around the ground glass ball which is also a good diffuser and softener of light.

Fig. 31 gives the distribution of light about a 16-cp incandescent lamp enclosed in a "Holophane" spherical globe, placed upright. This should be compared with the illumination obtained from a bare incandescent lamp placed upright and also from an incandescent

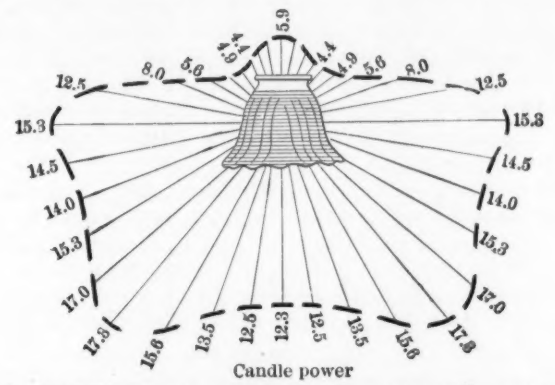


FIG. 32.—DISTRIBUTION OF LIGHT FROM "HOLOPHANE" OPEN SHADE.

lamp enclosed in the various diffusing globes before shown. The distribution of light from lamps and globes placed upright can, of course, be easily obtained by inverting any of the diagrams

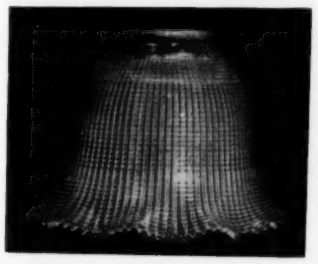
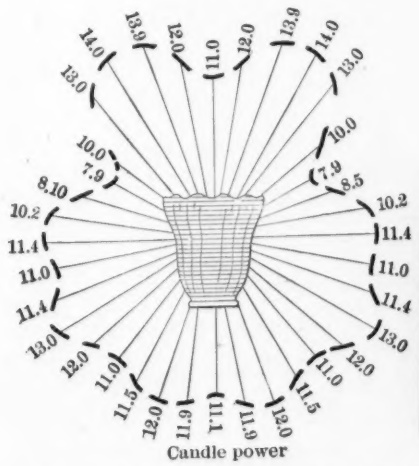
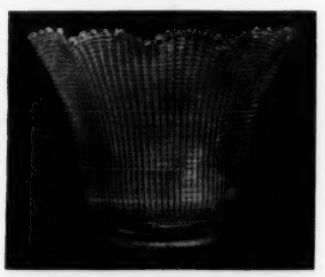


FIG. 32A.—"HOLOPHANE" OPEN SHADE.

before given. The "Holophane" ball, from which test Fig. 31 was obtained, is shown in Fig. 31A. This globe offers a valuable means of increasing the illumination in downward directions from



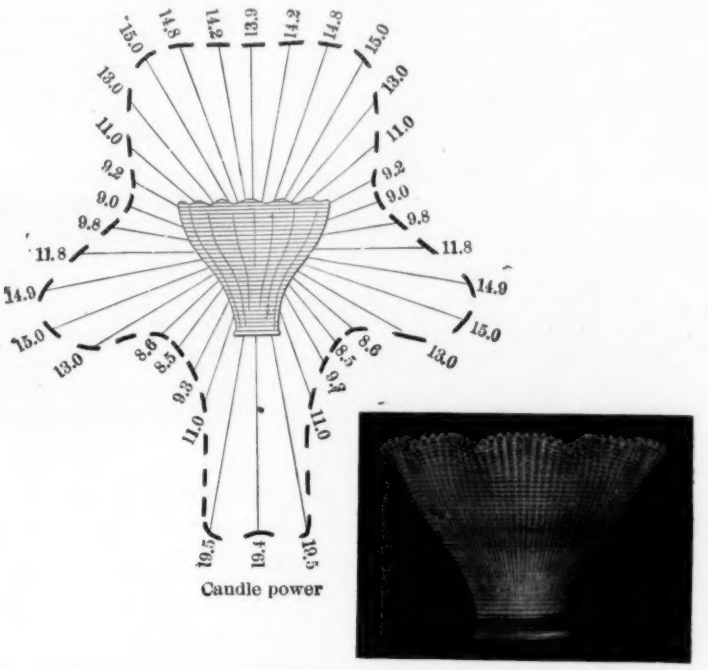


FIGS. 33 AND 33A.—DISTRIBUTION OF LIGHT FROM "HOLOPHANE" OPEN SHADE.

all kinds of fixtures where the incandescent lamps are placed upright. The majority of bell-shaped shades when placed on such upright fixtures have the effect of robbing the lower part of the room of light and throwing even more light towards the ceiling than would go there if the lamp were bare. This globe distributes the light below the horizontal in such a way as to give a fairly even illumination all over the lower part of a small room.

Fig. 32 shows the distribution of light about a 16-cp incandescent lamp placed in a "Holophane" open shade, designed for use as a pendant, and shown in Fig. 32A. As seen from test, this globe is of the type which increases the illumination in downward directions. When such a shade is used on a chandelier, it should be placed on sockets which are pointing straight down only. If used on sockets placed at angles of 45 degrees, it will not only throw more light up than is compared to the distribution of light around the ground glass ball shade.

Fig. 33 shows the distribution of light about a 16-cp, upright incandescent lamp, in a "Holophane" open shade, shown in Fig. 33A. This shade is mainly useful as a diffuser, although it increases the useful illumination immediately below the lamps.



FIGS. 34 AND 34A.—DISTRIBUTION OF LIGHT FROM "HOLOPHANE" OPEN SHADE.

Fig. 34 shows the distribution of light about a 16-cp incandescent lamp upright in a "Holophane" open shade, shown in Fig. 34A.

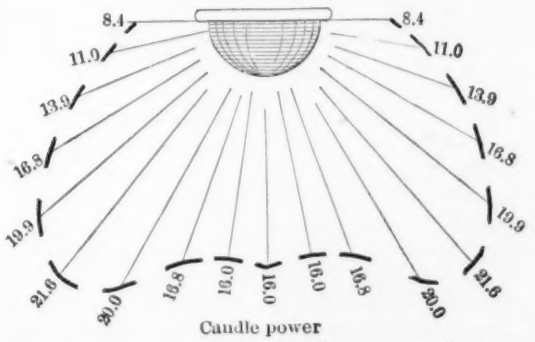


FIG. 35.—DISTRIBUTION OF LIGHT FROM "HOLOPHANE" HEMISPHERE.

This shade is designed to make a marked increase in the illumination immediately below the lamp, in which it succeeds very well, as within a narrow angle below the lamp it gives about 20 candle power. This shade can be used to advantage where it is desired

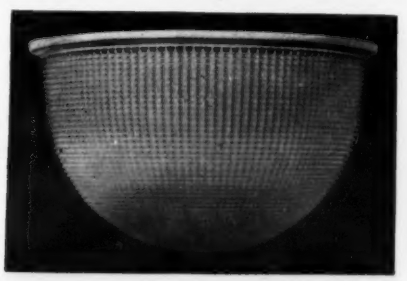
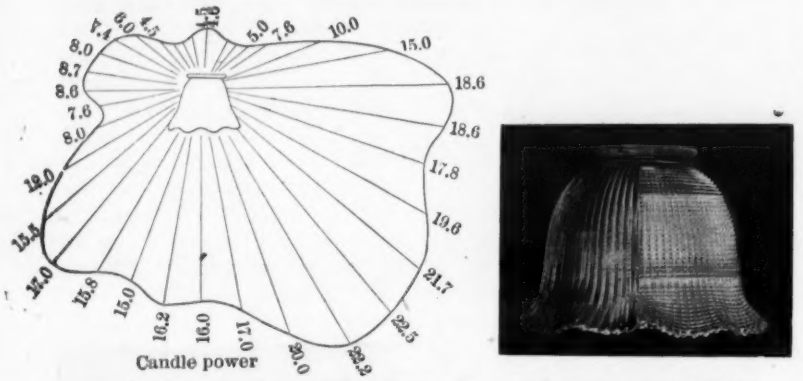


FIG. 35A.—"HOLOPHANE" HEMISPHERE.

to secure good light for reading or writing under chandeliers or brackets equipped with upright incandescent lamps. Similar globes are made for gas burners, and since the light from a gas burner is distributed in much the same way as from a bare upright incandescent lamp, there is an opportunity to so increase the illumination immediately below a gas burner by use of such a shade just as in the case of the incandescent electric lamp.

Fig. 35 shows the distribution of light about a 16-cp incandescent lamp placed in a "Holophane" hemisphere designed for use on ceilings and shown in Fig. 35A. This shows a very decided increase in the amount of useful downward illumination by the use of this hemisphere as compared to the ground glass hemisphere, before shown, the latter being used for the same purposes. The illumination at all angles below the horizontal can be increased in this and



FIGS. 36 AND 36A.—DISTRIBUTION OF LIGHT FROM COMBINATION "HOLOPHANE" AND "PAGODA" GLOBE AND REFLECTOR.

all other types of bowls or hemispheres by the use of the proper reflector over the lamp inside the hemisphere.

Fig. 36 shows the distribution of light around a 16-cp incandescent lamp, placed in a combination "Holophane" and "Pagoda" globe and reflector, shown in Fig. 36A. It is designed especially for use on wall bracket fixtures. This globe consists of a "Pagoda" prismatic reflector on one side and a "Holophane" globe on the other, the two features being combined in the one globe. In the use of such globes it is manifestly advisable to take unusual precautions to prevent their being turned around so as to throw the maximum light towards the wall instead of away from it. This globe makes a decided increase in the amount of illumination thrown away from the wall if properly used.

Central Station Operating Points at Kewanee, Ill.

Kewanee, a rapidly growing manufacturing town in central Illinois, to which the 1900 census gave a population of 8,332 and which is now undoubtedly a town of 12,000 inhabitants, has a very well constructed central station operated by the Kewanee Light & Power Company, which company also owns the gas plant of this city. It is unusual to find a small central station so substantially constructed. The building is of brick, with concrete floor in the engine room and brick floor in the boiler room. The roof is of slow burning construction supported on steel trusses.

All the generating units at the station are direct connected. The greater part of the company's load is on a direct-current 110 and 220-volt, 3-wire system. Two 125-volt generators are coupled together and placed in line with two high-speed engines, to either or both of which they can be connected by clutches. The arrangement works fairly well except that there is a little difficulty in keeping engines and generators in alignment, which results in the clutch rattling when they are out of line. No difficulty, however, has been experienced with hot bearings on account of mis-alignment. The advantage of this arrangement is, of course, that a small engine can be used to drive the generators during hours of light load. Besides the 125-volt generators, there is a 250-volt, direct-connected generator. A direct-connected alternator used for supplying the residence and outlying districts is of 150-kw, three-phase, 2,300 volts.

The company is at present considering the matter of the best way to take care of increase in business; whether to put in a storage battery on the direct-current system and put new power business on that system as far as possible, or to extend the alternating-current business. At the present time, the alternator is shut down during daylight hours. Twenty-four hours' service is given on the direct-current system. If the storage battery is put in on the direct-current system, it will be used both to assist at the peak and to carry the load when it is light.

The plant is kept as neat as a pin, and on account of its cleanliness and substantial character, cannot but make a favorable impression on prospective customers, especially those who contemplate depending on the central station for the operation of large motors.

TAR BURNING.

As the company operates the gas works, which is on the same property as the electric light plant, it always has an abundant supply of tar as a by-product, and provision is just being made to use some of this tar as a fuel under the boilers, first to assist in carrying peak loads, and second as a reserve in case of coal blockades or strikes. The company has a tar tank 32 ft. in diameter and 16 ft. deep, which will hold 75,000 gal. of tar. This tank, it is calculated, will hold enough to operate the station for three weeks should the coal supply be cut off. The company, therefore, has in its tar tank a compact fuel storage which is not to be despised; the 75,000 gal. of tar is considered the equivalent of 200 tons of coal. Provision for burning is made by installing some tar burners constructed by the Connelly Iron Sponge & Governor Company, New York. With these burners, the tar is piped to the front of the boilers and allowed to run in a stream into the funnel on top of the burner. In the burner it is mixed with a jet of steam and is ignited as soon as it enters the fire box. It is ordinarily used in connection with coal; a thick bed of coal being kept over the grates. The burners are arranged so as not to interfere with the coal fire, which is replenished about every 30 minutes. It is an easy matter to force boilers during the peak load with the tar burners in operation.

RATE CLASSIFICATION.

The company has a rather unusual method of determining meter rates. This method in general is to classify different lines of business according to the character of the load they afford. Thus, long hour users are put in a classification which gives them the lowest rates. This classification arrives in effect at about the same results as some of the maximum-demand, readiness-to-serve, and two-rate methods. The minimum bill is 50 cents per month. Miscellaneous unclassified customers are charged 15 cents per kw-hour. This includes residences, churches, and miscellaneous customers not long-hour users. The lines of business which are charged less than 15 cents per kw-hour, and the rates are as follows: Grocery stores, 12 cents; dry goods stores, 12 cents; clothing stores, 10 cents; saloons, 7 cents; drug stores, 7 cents. All these rates are subject to 10 per cent discount for payment within ten days from the date of the bill.

The company owns the commercial arc lamps, most of which are of General Electric manufacture. The time allowed between trimmings is about 75 hours. The peak load is about 2,200 amperes direct-current at 110 volts, and about 100-kw in alternating-current.

METER WORK.

Customers' meters are tested once a year ordinarily, although some of the larger customers' meters may be tested as often as once in six months. The company has about 500 meters on its lines. These meters are brought into the station to test, and it is interesting to note that the testing of these 500 meters makes just about enough work for one man, who devotes his time to it from one year's end to another. The meter tester is a man trained at the factory. When meters are removed from a customer's premises for test, they are usually brought back the same day. This saves connecting up a new meter in place of the one to be tested. The meter tester does all the work of taking out, testing and replacing meters, using a bicycle for transportation when the weather permits.

Most of the meters are the Thomson commutator type. For meter testing, the instruments used are a General Electric indicating wattmeter, ammeter and voltmeter.

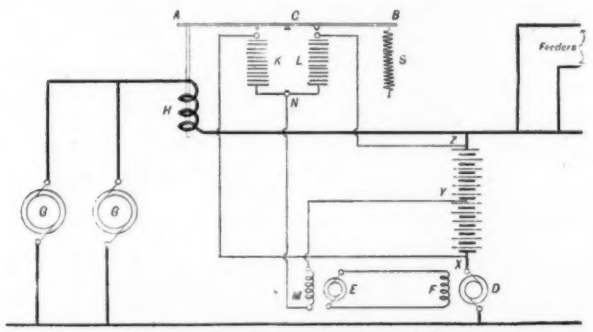
The meter cards are looked over each month after the meters are read, and any unusual readings of meters are noted and the cause at once investigated, no matter whether the readings are high or low. This puts a check on dissatisfaction of customers should the meter happen to be running fast, as the company would find it out before the customer received his bill and make deductions accordingly. It might also in certain cases prevent the burning out of a meter or transformer through increase in the customer's load unknown to the company.

The president of the Kewanee Light & Power Company is Mr. X. Caverno, who is prominent in the Illinois State Electric Association. The office details of the business are looked after by Mr. B. C. Parkinson, secretary and treasurer, while the electrical and mechanical operation is under the charge of Mr. E. W. Smith, superintendent.

December Meeting of the American Institute of Electrical Engineers.

At the meeting of the American Institute of Electrical Engineers which was held on December 15, there were presented two papers dealing with the general subject of railway sub-stations. The paper by Mr. Sidney W. Ashe, which was given the title "The Relation of Railway Sub-station Design to Its Operation," considered exclusively synchronous-converter sub-stations and treated of the following factors: The best method of starting converters, the protection of converters, the use of oil switches when synchronizing, the regulation of load, the best arrangement of switch gear, the operation of reverse-current relays, the adjustment of load between the sub-stations which feed the same circuit and the noiseless operation of synchronous converters. Outline descriptions were given of the three methods usually employed for starting converters, namely, from the direct-current side, by means of a small direct-connected induction motor and from the alternating-current side.

The author stated that the usefulness of storage batteries in railway work is being more and more appreciated, as evidenced by their recent applications. An interesting development in connection with storage batteries is a carbon regulator put to use during the last year. It consists of a variable carbon resistance which is used in connection with pilot cells and an exciter, to vary the excitation of the field coils of a booster. Referring to the accompanying diagram, *H* is a solenoid carrying the total generator load, which acts on



AUTOMATIC REGULATOR FOR RAILWAY BATTERIES.

a soft-iron plunger suspended from the lever, *A B*, of the carbon regulator. At the other end of the lever is a spring, *S*, whose tension is adjustable. *K* and *L* are piles of carbon discs on the opposite sides of the fulcrum, *C*, of the lever. The resistance of these piles is altered by slight variation in mechanical pressure, produced by slight fluctuations of current in the coil, *H*. The details of the electrical connections are self-explanatory. The battery booster is represented by *D*, *F* being its field coils. *E* is a small exciter, whose field coils, *M*, are connected to the carbon regulator as shown.

The operation of this regulator is as follows: As the lever arm is raised or lowered the resistance increases in one arm and decreases in the other, causing wide variations in voltage across the exciter field coils, the direction and intensity of the current in the coils varying accordingly. The action is somewhat analogous to that of Wheatstone's bridge. With the polarity of the booster changing and its field excitation varying in intensity, it is possible automatically to charge the main battery or to raise the battery voltage so as to carry part of the load of the bus-bar. By limiting the motion of the lever arm it is possible to limit the load which the battery will carry under extreme conditions. Experiments have shown that by the use of this system close regulation of the load on the converter is obtained.

In commenting on the criticism which has been directed against continuous reverse-current relays, owing to their sensitiveness, the amount of adjustment they require and their ability to perform their service at all times, the author stated that while these criticisms are partly warranted, the fact remains that such relays are better than no protection at all. If reverse-current relays were not sensitive they would be practically worthless. Hence the features which appear to make the instrument objectionable are necessary elements of its successful application.

The paper by Mr. C. W. Ricker dealt with "Some Considerations Determining the Location of Electric Railway Sub-stations," and tended to show the method by which Kelvin's law may be applied to the selection of the most economical number of sub-stations for a certain railway. It is required to adjust the cost of losses in the primary distribution, the secondary distribution, including the track, and the sub-stations, the fixed charges upon each of these three divisions, and the cost of sub-station attendance, so that their sum shall be a minimum, with due regard to the conditions of regulation and continuity of service. As the density of the load in a system wholly within a large city is very great, the unit of sub-station equipment for such service may be made large enough that at the time of least load one unit per sub-station may be operated at or near its best efficiency. Hence the sub-station losses per kilowatt-hour may be considered constant.

The aggregate capacity of the sub-stations will equal the capacity of the generating station plus the sub-station reserve capacity, which will not exceed one unit per sub-station. The greater the distance between sub-stations, the larger the sub-station unit will be; hence, the cost of sub-station apparatus will decrease as the number of sub-stations increases, until the largest practicable unit is reached. The same is true of sub-station land and buildings. The cost of sub-station attendance will depend only upon the number of sub-stations, as the same number of attendants is required in a small as in a large sub-station, unless the cost of land makes it necessary to double-deck the sub-stations, in which event there will be a sharp rise in the cost of attendance when the number of units becomes greater than can be placed on one floor.

When direct-current motors are used the secondary voltage is fixed by conditions of standard practice. The secondary conductors may be proportioned by Kelvin's law, subject to the limiting condition that the lowest potential shall be enough to allow the required acceleration. As the number of sub-stations increases, the cost of the conductors will decrease rapidly. The energy losses in the conductors may be constant or decreasing. The primary distribution in this case must be by underground cables. The primary voltage will be determined by the relative cost of copper and insulation, and should be as high as is consistent with safety. Hence the losses per mean kilowatt in the primary distribution may be considered constant. The total weight of primary conductors will be practically independent of the number of sub-stations, depending upon the total energy and the mean distance of distribution, and it may be determined by Kelvin's law.

To obtain the greatest reliability of service, each sub-station should be fed directly from the generating station by at least three cables, and in the case of a wide difference in the number of sub-stations considered, the total cost of cables and conduits would be somewhat greater with the larger number of sub-stations as more and smaller cables would be required. Otherwise the cost of the high-tension distribution, and the losses in it, may be considered constant. Neglecting those quantities which are constant, the fixed charges on sub-station land, buildings and apparatus and the cost of sub-station attendance increase as the number of sub-stations increases; the fixed charges on the secondary distributions decrease and the losses in the secondary distribution decrease or remain constant.

The various losses and charges upon which the solution of the problem depends may then be considered as constants or variables dependent directly upon the number of sub-stations and inversely upon the distance between sub-stations. These quantities may be reduced to a common base of annual kilowatt-hours, and curves representing them may be drawn with respect to the number of sub-stations as one co-ordinate, and a summational curve may be drawn which, if the premises are rightly chosen, will indicate the number of sub-stations at which the sum of the various charges is a minimum.

The discussion was opened by Mr. H. A. Lardner, who called attention to the fact that in rotary converter sub-stations of the average interurban railway, the sub-stations are entirely shut down every night, and unless storage batteries are included in the equipment of these sub-stations, no direct current is available for starting the converters in the morning. Therefore, it becomes necessary to include one other method of starting converters. The method of starting the converters from the alternating-current side has many advantages; among them are great simplicity and the omission of special apparatus. The introduction of taps running from the middle points of the transformers is a very slight modification, and the double-throw switch required is also a small matter. Fur-

thermore, the division of the field coils is not seriously objectionable. Where the size of rotaries is 500 kw and under it is desirable to use the alternating-current, self-starting method for placing the first converter in operation in the morning, when no direct current is available, and to use the direct-current method for the addition of other units at any time during the period of operation.

Mr. W. I. Slichter remarked that in addition to the method involving the application of an induction motor in starting rotary converters, there is another method of indirect starting by the use of a single-phase commutator motor. The alternating e.m.f. of a rotary converter is approximately the voltage which is suited for a single-phase commutator motor, and by putting a reactance in series with such a motor an easy means can be obtained for regulating the voltage and the speed. By this method it would be easy to secure the proper speed for throwing the converter into synchronism.

Mr. John B. Taylor stated that there seems to be a general impression that the purpose of the reactance coil in series with the armature winding of a converter is to permit starting from the alternating-current side. As a matter of fact, however, the reactive coil is used for several reasons: to permit automatic compounding, to compensate partially or wholly for the line drop, and the drop in the transformer and converter itself; and it also allows the converter to run under variable load with comparatively slight changes in power factor, so that it is almost unnecessary for a station attendant to make any changes in the field rheostat at any time during the day. It also readily permits the division of load between converters. All such factors as brush resistance and field resistance become of small importance when reactive coils are installed. Although almost any rotary converter may be started from the alternating-current end with 25 per cent of full voltage and some of them, if the armature happens to be in a favorable position, may be started with from 17 to 18 per cent of full voltage, the usual practice is to employ one-third voltage so as to insure starting under all conditions and to make the practice uniform. It is well to note the effect of the action of the auto-transformer when the rotary is being started. The current on the line varies with the square of the voltage on the secondary taps. That is to say, one-quarter voltage will require current in the ratio of 9 to 16, compared with that taken by one-third voltage.

Mr. H. G. Stott thought that the importance of the line drop had not been properly emphasized. When a synchronous converter is operated with a line drop of 12 per cent, there is difficulty in holding it in synchronism, and its operation generally will be unsatisfactory. This fact is of moment when a converter is started from the alternating-current side. If the line is fairly well loaded and there is a drop approximating 10 per cent, if a converter of relatively large capacity be started, there may be such a drop as to start the other converters hunting, and to cause a flashing at the brushes. This fact also has a strong bearing on Mr. Ricker's paper. That is to say, the limiting conditions in the location of sub-stations is set by the line drop and it must be borne in mind that a maximum of not more than 15 per cent drop can be allowed.

Mr. E. H. Hewlett, in commenting on the possibility of oil switches not working properly, said that, while some of the first switches were defective in this respect, switches are now made with a positive stop and a trip coil, which moves the stop out of the way, so that the "pumping" of switches is unknown where they are given reasonable care.

President Wheeler related some of the early experiences in the paralleling of direct-current dynamos, in which great difficulty was encountered on account of the sensitiveness of the governors of the driving engines. The difficulty was overcome by connecting the levers of the centrifugal governors together so as to compel the engines to run at the same speed and not to "pump." While it is infinitely easier to run direct-current machines in parallel than alternating-current machines, he expressed the opinion that the problem with the alternating-current machines is the same problem much intensified.

Mr. D. B. Rushmore remarked that while in small sub-station installations the compound coils are generally used, such seems not to be the case with large interconnected systems. In regard to the "hunting" of synchronous converters, a considerable portion of it can be attributed to the reciprocating steam engines. As these engines seem to be going out on account of the introduction of steam turbines and the extending use of hydraulic turbines, it is to be hoped that in the future very little will be heard of the hunting of synchronous converters.

Prof. R. B. Owens, of McGill University, called attention to the fact that the main consideration in connection with the location of electric railway sub-stations was omitted by Mr. Ricker's paper, namely, the voltage. Without going into the question of whether or not direct-current generators can be successfully designed of large size, for voltages of 1,000 or 1,500, or 2,000, it is believed that the makers stand ready to furnish rotary converters of 1,000 volts, maybe more, and also at least bi-polar motors that will operate successfully at such voltages. If this is true it affects the whole question of sub-station location most materially, and materially interferes with the field which some people suppose the alternating-current motor system occupies. The gist of the whole matter depends upon the value to which the direct voltage can be increased. The solution lies in the design of direct-current machinery, in large units, at high voltage, to operate successfully under conditions met in traction work.

Mr. William McClellan thought that the method proposed by Mr. Ricker would apply very well where trains move over the road without any particular points of congestion; but in any practical case it is necessary to consider the location of each sub-station in connection with the existing conditions.

Dr. C. P. Steinmetz stated his belief that for a long time to come, if not for ever, the largest number of railway sub-stations will remain converter sub-stations. It is proper, therefore, that much attention should be devoted to the rotary converter. The railway converter sub-stations can be divided into two typical classes: the sub-station in a large high power distribution system and the sub-station in an interurban system. In the former class the loss between generating station and sub-station and the drop of voltage between sub-stations is very small. The sub-stations contain a large number of large units which run practically always at steady full load. The individual momentary variations of load are not perceptible in the sub-station to any great extent, and the daily changes of load are taken care of by varying the number of converters. In such sub-stations the possible variation of voltage due to line drop is insignificant. Automatic control of voltage for variations of load on the converter is not necessary, since the converters are maintained at fairly steady voltage. Therefore, automatic voltage controlling devices, as compound field coils and reactive coils, are not necessary, but the shunt-wound converter is suitable, and therefore it is undesirable to have in such sub-stations series field coils on the converters and reactive coils, since they are an unnecessary source of a possible danger, the danger of racing in case of the direct-current system feeding back into the converter sub-station, which danger, due to the small resistance between sub-stations, is greater than in the interurban sub-station, which is the second class of sub-station.

In the interurban system class moderate-sized sub-stations with two or three units of converters of, say 500 kw or less, are fed from long-distance, high-potential transmission lines with considerable drop of voltage in the transmission lines and very considerable resistance between the sub-stations. In these sub-station systems the variation of load would be impracticably large for any ordinary methods of voltage control to be used. Therefore, these sub-stations utilize powerful series field coils and reactive coils. That is what has been called phase control. In the operation of a converter sub-station the most important matter is the starting of the converters. In the early days the first systems were started from the alternating-current side by throwing full voltage on the converter or synchronous motor and letting it get up to synchronism. The starting from the alternating side gives the severest jolt on the system, especially when using full voltage. The converter may also be started either by a special motor or from the direct-current side, and then synchronized. The methods of starting can, therefore, be divided into two large classes: those methods which require synchronizing devices and those which do not require these devices. There may be some difference in the time required to start; it may take a little longer time to synchronize, but in either case the minimum time is sufficiently short so that either method would be suitable. The method of starting, which requires synchronizing devices, is the least severe on the system. A converter may be put into the system without any trace of disturbance. This method was introduced to a large extent to

avoid shock on the system, but recently the tendency has been strongly away from it, and at least in interurban systems, it may almost be said that the methods of starting which require these devices have failed. They have failed because under just those conditions where the utmost rapidity of starting is essential, where there is trouble in the system, or heavy overloads, where the direct voltage cannot be held up and begins to sag down to nothing, and where in the alternating-current system the voltage goes up and down, the machines cannot be synchronized safely. These are the main reasons for re-introducing the alternating-current, self-starting method. It is true that a specially skilled operator might be able to get the converter in operation in this manner without throwing out the whole sub-station, by closing the switches not at equality of frequency, but when the two frequencies approached each other, while they are yet coming together, because it is impossible to synchronize them while they are together. The speeds cross each other at such rapidity that they are immediately again apart, and there is the danger of improperly estimating the time and thus of short-circuiting the system and throwing out the other converters just when they are most needed. In general the proper moment for closing the switches is not when the machines are in step and in synchronism, but just a moment before they are in synchronism. That means that direct-current starting is of questionable usefulness in interurban systems. In the large metropolitan sub-stations the difficulty is largely reduced, because the voltage is steady on the alternating side as well as on the direct-current side. At the same time in these systems if a machine is thrown in when out of synchronism the result is much more disastrous, because there is almost no resistance between the generating station and the sub-station or between the sub-stations, and all the momentum of the whole system feeds back into the converter, thus reversing the converter at full voltage. Even with the most skilled operator that may occasionally happen. Assuming the efficiency of the operator as very high, that his liability to error is only one-hundredth of one per cent, that he will make a mistake only once in 10,000 times, if one considers a city like New York, where more than 100 converters of 1,000 kw or more have to be thrown into the system daily, it will be seen that one in ten thousand means three times a year some big converter is thrown in wrong, and tears down the whole station, with the usual disastrous results. This fact gives the preference to starting from the alternating side by means of low voltage. A compromise of the direct-current and the alternating-current methods of starting has been developed to reduce the jolt on the system. The start is made from the direct-current side and the machine is brought up almost to synchronism. The direct-current side is disconnected and the alternating-current switch is closed. The converter drops in step almost instantly and there is no appreciable jolt on the system.

In discussing the hunting of converters, Dr. Steinmetz stated that there are several modifications of the anti-hunting devices. One of the most effective is a squirrel-cage induction motor. That is the most effective anti-hunting device, and it is largely used in synchronous motors intended for very severe conditions, as for operating heavy fluctuating loadws at the end of a long transmission line with heavy resistance losses in the line. It is obvious that such a squirrel-cage induction motor is of a great advantage in starting the converters. Two other devices are short-circuits around the field pole and short-circuits between the field poles, each depending for its operation on the shutting of the magnetic flux. When hunting the magnetic flux vibrates across the field pole. The short-circuit current around the field pole is due to the change in the magnetic flux. The short-circuit between the field poles obviously cannot interfere with starting, but they act as self-starting motors, giving a quarter phase winding to the normal pole and produce the effect of a quarter-phase motor. The other arrangement of short-circuiting around the field poles is used to a considerable extent in synchronous motors. There seems to be no good reasons why they should not be very satisfactory in connection with rotary converters.

The storage battery is a very useful and desirable element in a railway system. The only and main objection to a storage battery which has practically killed its introduction in most railway systems, especially in interurban systems, is that the cost of the storage battery as a rule is so great that an interurban railway cannot pay for it, or cannot be sure to earn sufficient money to pay the interest on the investment in the battery.

New Telephone Patents.

SWITCHBOARD CIRCUIT SYSTEMS.

Every little while we find a patent issued which has been held up so long that the invention covered has in the interim become most commonplace. We have this week at hand for consideration two such patents, issued to M. G. Kellogg, the applications for which were filed twelve or more years ago. Both refer to switchboard circuit schemes. One covers a system in which high impedance drops are permanently bridged across the lines for line signals, while clearing-out drops and bells are legged off both sides of the line in parallel to ground. A battery in the clearing-out drop circuit renders that signal automatic in its action.

The second patent covers a divided multiple switchboard arranged in two main sections, and involves the use of the two sides of the lines individually in order to select the line signal at one or the other board. The signals are, of course, legged off one or the other side of the line to ground.

Fig. 1 shows a circuit scheme patented by H. T. Cedergren, of Stockholm, Sweden. With such a system the cords of a common

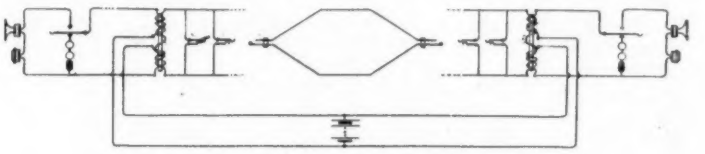


FIG. 1.—CEDERGREN SWITCHBOARD CIRCUIT.

battery system are kept free from current, as are also the jacks. It is unfortunate that no means of signaling is shown.

SUB-STATION APPLIANCES.

A telephone shelf for clamping on a wall telephone forms the subject of a patent granted to J. S. Gold, of Jackson, Ohio. This carries the usual writing shelf on the right, and extends to the left as an arm rest. As a novel feature it is provided with a support for holding a receiver when it is not ready to be returned to the hook. This support comprises a notch with a cover so arranged as to close normally the slot and thus warn users against absent-mindedly using it in lieu of the hook.

J. Silverman, of San Francisco, has been granted a patent for a receiver support arm which has rather elaborate adjustments and automatically controls the hook switch, the latter a most invaluable feature. There appears to be little to distinguish this device from many of its predecessors.

A transmitter disinfecting shield has been jointly patented by M. F. and W. B. Hubbard, of Boston. It consists of a disinfecting screen and a clamp for securing it across a transmitter mouthpiece.

From protection against lightning some persons feel that the best form is a manual device for breaking the line and grounding it. Such devices are rarely seen except in sparsely settled districts.

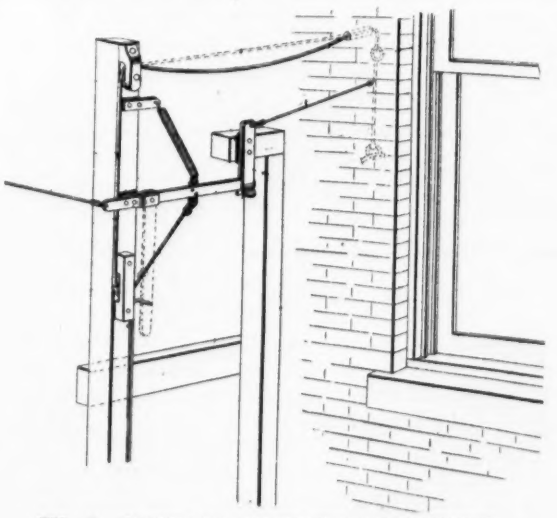


FIG. 2.—FLETCHALL TELEPHONE DISCONNECTOR.

Fig. 2 shows one which is typical, this the invention of L. J. Fletchall, of Hatfield, Mo.

TRANSMITTER.

A rather peculiar transmitter has been invented by J. Prince, of

Milford, Mass., in which the usual carbon granules have been abandoned in favor of a mixture of copper, zinc and magnetic iron ore granules. The carbon electrodes, in addition, are supplemented by plates of zinc and copper. The transmitter is designed for use with apparatus for enabling the deaf to hear and is intended to be sensitive. Unfortunately, the inventor gives no hint of what particular advantage may accrue from his mixed electrode.

PARTY LINE SYSTEMS.

A. R. Hoover, of Pleasanthill, Ill., has brought out a party line system in which all bells are in local circuits and are controlled by relays included in a bell line circuit auxiliary in the talking circuits. The bells operate irrespective of the number of stations, the relays alone requiring sensitiveness. The bells are rung on a code system.

Another party system, this of a step-by-step nature, has been invented by A. J. Farmer, of Detroit, Mich. He selects a nucleus where both main and branch lines are brought and connected to a single switching machine. Through a series of impulses sent out over the main line the switching device may be rotated to connect up the parties in any desired grouping, or to the main line.

LETTER TO THE EDITORS.

The Patent Question.

To the Editors of Electrical World and Engineer:

SIRS:—The editorial in your issue of November 18 on "The Patent Question Again," is one which makes some suggestions which are valuable, and also one which appears to show a misunderstanding of what letters patent purport to be. The opinions based upon this misunderstanding are obviously not of value.

No doubt the statement by a patent lawyer that the last thing he desires is complexity, ambiguity or uncertainty in the patent law will be received by most laymen with incredulity, since they commonly suppose that these characteristics are the very source of the patent lawyer's income. However, the statement is true, and the better the practitioner the more truthful it is. I say this because the best of the patent lawyers have for years given freely of their time and energy (and where needed, their money) to improve and perfect the patent law, both on its theoretical side and in its practical application to existing situations. Every improvement is their work, and in the last ten years many have been made, such as the act making United States patents independent of foreign letters to the same inventor, etc. Those who have been most active in this good work realize most fully its great difficulty and its enormous importance; and those who are not experts in the present status of the patent law are seldom capable of making suggestions which prove of any value, or at least seldom do so.

The idea advanced by you that "a reference over which a patent has been allowed should certainly not be permitted as a citation against it in litigation," contains a germ of valuable suggestion, no doubt original, but very old. To realize it, however, requires that we should upset all of our preconceived notions of general law, which require that no man shall be condemned without a hearing. The practical application of the maxim in this case is that the proceedings in the Patent Office are *ex parte*, and that the conclusion reached between the patentee and the examiner cannot fairly be held to bind a third person who has not been heard upon the question. That no controlling weight should be given to such references, however, seems obvious; in fact, decisions show that the courts are chary of invalidating patents upon only those references cited in the Patent Office, and there overcome.

The proposition, however, that "a patent once issued ought to carry with it the highest presumption of full validity and *should protect its owner in the right of manufacture*" may well be characterized as "revolutionary," though the writer of that sentence could hardly have understood what it would revolutionize, the trouble being that he did not at all understand what letters patent are. They convey *absolutely no right to manufacture*, for it is self-evident that the Government cannot convey a right which it never possessed. In the theory of the patent law the invention is the inventor's secret, which he surrenders in return for the guaranty of its *exclusive* right in himself for a limited term; mark the word *exclusive*, for what the Government gives is not the right to manufacture, but *the exclusive right;* that is, a right to exclude all others, but not necessarily the right to make it one's self.

The effect of such a change in the law, if it were possible and were within the power of Congress, would be very far from salutary. It would effectually and at once put an end to all attempts to disclose to the public through letters patent inventions of importance, since the only effect of the disclosure would be to permit others to make improvements upon the original invention and then (without fear of infringement suits) proceed to manufacture the improvements, thus driving out of the market the original inventor. Dr. Alexander Graham Bell, for example, would have objected to the Government licensing the manufacture of competing (improved?) telephones without accountability to him; or perhaps Mr. Edison would not have been willing to have the various infringing lamps manufactured under the guise of improvements.

The paper of Mr. J. E. H. Hyde and the discussion of it (A. I. E. E., Vol. XVII, p 247) completely disposed of the "independent expert" fallacy. It is not fair to prevent either side proving what it will, or can, relative to the issue. Independent men may err; if so, they must be contradicted—probably by both sides—and thus the short cut simply increases confusion by making a judge choose among three opinions instead of between two.

I fully agree with the undisclosed patent lawyer who commented in your issue of November 25 on the suggestions of Mr. Ludwig Gutmann as printed in the issue of August 26. A part of the difficulty has arisen from the crude notion that the Government by issuing a patent, licenses somebody to infringe the patent of someone else; a further part from the idea that inventions are always broadly distinctive, whereas most inventions, though truly such, are improvements upon broader ones previously patented; and a further part from the differences of opinion among the judges of our nine Circuit Courts of Appeals; for this part of the trouble no doubt the pending proposition for a Patent Court of Appeals would prove a solution. For the others a course of elementary instruction seems to be the only remedy.

NEW YORK. T. J. JOHNSTON.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Turbo-Alternator.—REYVAL.—An illustrated description of a turbo-alternator, exhibited at the Liege exposition. It consists of a 600-hp Rateau steam turbine, directly coupled to a 400-kw, three-phase alternator, compounded according to the Blondel system. The number of revolutions per minute is 3,000. In Blondel's compounding system, the exciter consists of a small bipolar converter, mounted on the shaft of the turbine and supplied through three brushes with three-phase currents which are then converted into direct-current for excitation. These three-phase currents are furnished from a compounding transformer, the primary winding of which is in series with the supply network. The potential differences at the secondary terminals therefore increase with the load; and since the e.m.f. of the direct current, produced by the converter, is proportional to that of the alternating-current, the exciting current of the alternator increases with the load. The excitation of the small converter is a double one. One of the field circuits is shunted across the direct-current terminals of the converter so that the current in this circuit varies with the e.m.f. produced. The second circuit is connected to the terminals of a small exciter mounted at the end of the shaft of the converter and excited in shunt. This exciter produces a constant e.m.f. so that in one of the two field windings of the converter the exciting current is constant. The connections are shown in Fig. 1 where A is the armature of the alternator and B its field coils. T, C is the compounding transformer, i and i' are the field windings of the converter, containing rheostats Rh, which are adjusted once for all time. *"Comce"* is the converter. *"Exc"* its exciter. I is a three-pole switch, and f the phase lamps supplied by transformers,

T P, and used for parallel connection.—*L'Eclairage Elec.*, November 18.

The Influence of Armature Reaction on the Wave Form of Alternators.—BENISCHKE.—A paper illustrated by diagrams and oscillographs. The chief results are as follows: The non-symmetrical distortion of the fundamental wave of e.m.f. (of the phase e.m.f. in the case of three-phase generators) caused by the armature reaction, is essentially due to the energy component of the current, and is the same with leading or lagging current. The wattless component has either no influence on the wave-form at all, or it causes a symmetrical flattening of the e.m.f. curve with lagging current and a symmetrical peak of the e.m.f. curve with leading current. The voltage-drop with lagging current and the rise of voltage with leading current are due mainly to the wattless component and to a less extent to the energy component. The non-symmetric distortion of the e.m.f. wave is the smaller the narrower the pole shoes, other things being equal, and is smaller with three-phase alternators than with single-phase machines.—*Zeit. f. Elek.* (Vienna), November 19.

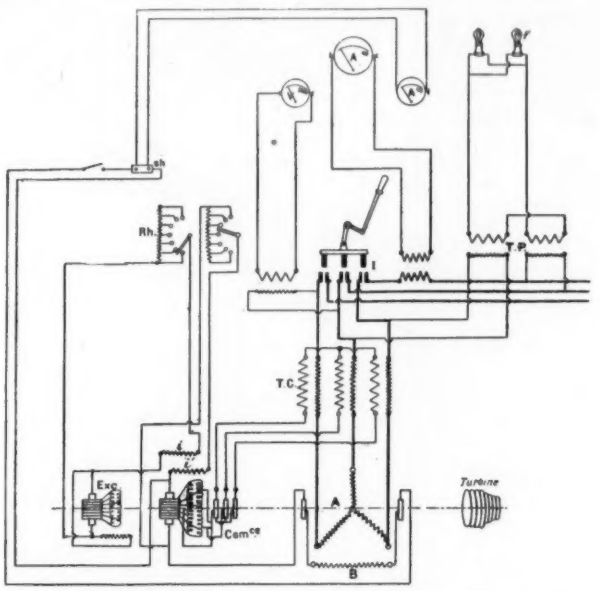


FIG. I.—DIAGRAM OF CONNECTIONS OF TURBO-ALTERNATOR.

Armature Reaction and Commutation.—In the department of questions and answers a subscriber refers to a turbo-generator with compensating coils electrically in series with the armature and placed mechanically in slots in the pole phases. The object of these coils is to enable the machine to commute sparklessly with a fixed position of the brushes at all loads. He asks for an explanation. There are three answers.—Lond. *Elec. Eng.*, December 1.

Turbo-Alternator.—A fully illustrated description of the new designs of Dick, Kerr & Company, and of large alternators for steam turbine drive. Detailed drawings and dimensions are given of two 3,000-kw turbo-alternators recently installed at Glasgow. The construction is described in detail.—Lond. *Elec.*, November 24.

LIGHTS AND LIGHTING.

New Incandescent Lamp.—"It is reported that electrical firms in Austria-Hungary are making preparations for the manufacture of a new glow lamp which is claimed to possess great advantages over the carbon-filament lamp, the Nernst, osmium and the tantalum lamps. The 'Wolfram' glow lamp, as the new lamp is termed, is said to consume only one-third of the power required by the best glow lamps at present imported into Austria. Most of the patents for the new lamp are held by a Hungarian electrical company, and the introduction of the lamp on the market, the Austrian, at all events, is in contemplation in the near future." (It is not clear whether Wolfram is the name of the inventor or is applied here as the German name of the element tungsten. The melting point of pure tungsten does not seem to have been exactly determined, but is stated to be above 1,900° C. Tungsten is mainly used at present in the form of ferro-tungsten for hardening steel).—Lond. *Elec. Rev.*, November 24.

Temperature and Efficiency of Thermal Radiation.—SWINBURNE.—A (Brit.) Phys. Soc. paper pointing out that it has long been known that various surfaces have different emissivities, and it is generally held that at a given temperature some bodies give off a larger percentage of their total radiation in the form of light. This view is largely based on some experiments by Evans and Bottomley. The researches of these scientists are criticised by the author on the basis of thermodynamical reasoning. Lummer's curves of the distribution of energy for a "black body" and polished platinum are compared, and show somewhat higher efficiency for platinum; but the comparison is difficult. The behavior of flashed lamps and incandescent gas-mantles is explained by the difference of emissivity without any need for selective emissivities. He believes there is no such thing as selective emissivity at all. He pronounces the rule that "in the case of pure temperature radiation, the light-efficiency is a function of the surface temperature only.—Lond. *Elec. Times*, November 16; Lond. *Elec.*, November 17.

Illuminating Engineering.—CRAVATH.—A paper read before the Western Soc. of Engs., on the necessity of better illuminating engineering. This branch of engineering does not concern itself with the production and distribution of light producing energy, but with the utilization of light after it is produced, in order to secure the best illuminating effects from an economical, artistic and hygienic standpoint. The chief problems are the selection of the proper illuminant, the proper location of the lighting units and their proper equipment as regards reflectors, shades and globes. The paper is fully illustrated showing proper and improper methods of illumination.—*Jour. Western Soc. of Engrs.*, October.

Long Filaments.—In notes on the recent Olympia electrical exhibition in London, mention is made of the Maxim system of continuous light, which is claimed to utilize the longest tubular filament yet made. While only quite short lengths—12-in. or so—were exhibited, yet it is said that there are in process of manufacture filaments four ft. long.—Lond. *Elec.*, November 17.

POWER.

Transmission Plant.—MANASSE.—In the conclusion of his illustrated article on the Kaiserwerke transmission plant in Tyrol the switchboard and the equipment of the sub-stations are described. In the latter, cascade-converters (the construction of which has been repeatedly described in the Digest) are installed for converting the three-phase current into direct-current. The frequency is 40. Various curves are given showing the behavior of the cascade-converter in actual practice.—*Elek. Zeit.*, November 16.

Niagara Falls.—ADAMS.—An illustrated article advocating the utilization of the power of the Niagara Gorge. The lower Niagara River falls 80 ft. in the length of 2½ miles with the whirlpool located nearly at the center of this length. This descent is substantially half as great as that of the great cataract above, and is made by the entire volume of water that passes over both the American and the Horseshoe Falls. The author thinks that either pipes or tunnels offer an entirely practical means of developing power in the Niagara Gorge.—*Cassier's Mag.*, December.

London.—In an article on new power bills for London a scheme is mentioned involving the establishment of a generating station at St. Neots and power transmission at 20,000 volts, partly on overhead line and partly through underground cables to London. The distance is 40 miles.—Lond. *Elec.*, November 24.

Electricity in Gun Factory.—HOLDEN.—The first part of a fully illustrated paper read before the (Brit.) Inst. of Elec. Engs. and describing the various applications of electric power in the Royal Gun Factory, Woolwich Arsenal.—Lond. *Elec.*, November 24, and December 1.

WIRES, WIRING AND CONDUITS.

A New Process for Covering Wires.—An illustrated description of a process of Phillips and Hutchins for the covering of wires with cotton and silk. Considering the smaller grades of covered wire, for instance, it is usual to apply a spiral winding of yarn, which, critically examined, reveals a corrugated covering, with intervening spaces between the insulating strands; by the new process, however, the inventors have sought to apply a homogeneous felt-like covering to the wire, of a thickness which can, with equal efficiency, be much less than that with yarn or thread. For cotton covering the material used is unspun roving, which is first passed through and attenuated by drawing rollers; these feed the fibres of cotton into a device, which incorporates a rapidly revolving hollow spindle of special construction, through which the wire is

fed. The spindle rotates inside a fixed casing connected to an exhausting fan. The combined result of the rotation of the spindle and the air suction is to create an air vortex over the head of the spindle, and the latter, as it rotates, draws out and spins the cotton fibers around the wire as it passes down through the head of the spindle. Fig. 2 shows the essential elements of the machine; *a* is the cotton roving passing through three pairs of drawing rollers, of which the front pair run at ten times the speed of the back pair,

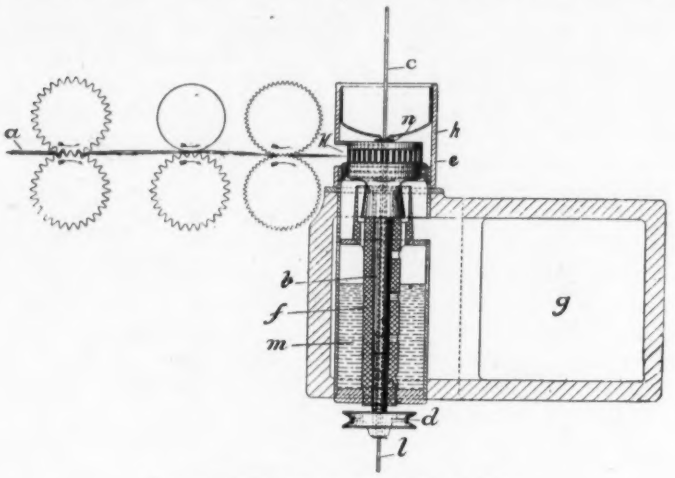


FIG. 2.—PROCESS OF COVERING WIRES.

thus attenuating the cotton. The hollow spindle, *b*, through which the wire, *c*, passes, is driven by pulley, *d*, and has a hollow, perforated head, *e*, the top of which is covered with wire gauze, having an eyelet in the center. The spindle, the total weight of which is under 2 ounces, runs at a speed of over 30,000 r.p.m. in a white-metal bearing, *f*, so arranged that there is a continuous circulation of oil, the lubrication being assisted by a spiral groove on the spindle. The hollow frame-work of the machine, *g*, is connected to an exhausting fan. The top of the rotating spindle is covered in by a fixed case, *h*, provided with a slot, *k*, through which the cotton is sucked. The intense vortex created inside the case, *h*, by the air suction, in conjunction with the rotation of the spindle, causes the fibers of cotton to be attracted to the center of the bronze gauze top of the spindle at *n*, where they are whirled round the wire, being afterwards firmly compacted on to it by a spring inside the slotted head, *e*. The machine is said to cover 85 ft. of wire per minute and at the same time to use covering material which represents a saving of from a quarter to three-quarters of the cost in the case of cotton and of some two-thirds cost in the case of silk, and, further, to permit of the finest grade of covering.—Lond. *Elec. Rev.*, December 1.

WIRES, WIRING AND CONDUITS.

Zinc Fuses.—SCHWARTZ AND JAMES.—Zinc and aluminum can be advantageously employed as fuses only in the form of strip. The

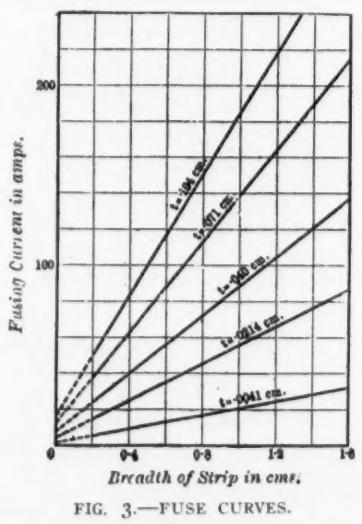


FIG. 3.—FUSE CURVES.

authors have made some experiments concerning the dimensions of zinc fuses. Fig. 3 gives curves connecting the fusing current and the breadth of zinc strip for various thicknesses, *t*. Fig. 4 gives curves connecting the fusing current of zinc strip and the thickness for different breadths, *b*. Zinc fuses show very little deterioration, even when run continuously at 90 per cent or even 95 per cent of their normal fusing current, the oxidation is very slight and the final resistance is practically the same as the initial resistance. This freedom from oxidation when run at high current density renders zinc a desirable material for fuses which are required to blow with only a slight overload. However, for a given fusing current the mass of zinc fuse is about 3.5 times that of a copper fuse of the same length, while its volume is approximately 4.4 times that of the copper, and this gives a large amount of metal

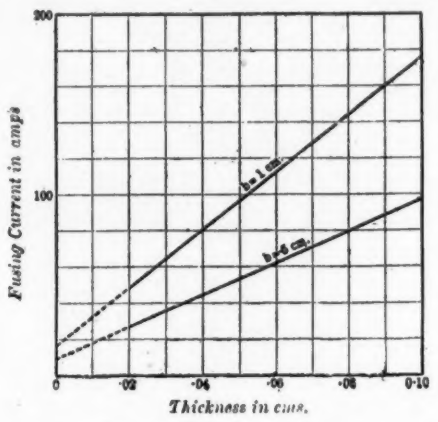


FIG. 4.—FUSE CURVES.

to be disrupted. The metal is disrupted in the form of globules which are not only red hot, but which continue to burn in air, and which are accompanied by dense white fumes which deposit heavily on contiguous surfaces. For these reasons, zinc when employed in enclosed fuse holders would require a larger cartridge than copper. The authors refer to the effect of reducing a fuse strip in breadth at the center for a short distance of its length; this helps to suppress the arc.—Lond. *Elec. Rev.*, November 17.

Standardization of Fuses.—SCHWARTZ.—An article giving general considerations on the standardization of fuses. The fire risk in connection with fuses should be greatly reduced, first, by standardizing the length of break not only for various circuit voltages, but also for various carrying capacities. Since the term "short-circuit service" is a relative one, the author suggests that the fuses might be arranged in two classes: One for fuses (usually of large carrying capacity) to withstand the severe conditions of a true short-circuit, the other for fuses (usually of small carrying capacity) for use on circuits of a non-inductive character and of moderate resistance, such as one usually finds in connection with house installation work. The author then deals with the specifications as to the material of the fuse, the rating, testing, contacts, spacing, classification and marking.—Lond. *Elec. Rev.*, December 1.

TRACTION.

Shunt-Wound Traction Motors.—JOHNSTON.—An article in which the author first gives some notes on the possibility of designing a shunt motor so as to get a high starting torque. Comparison curves are given for two motors of exactly the same design and size, one being series wound and the other shunt wound; the curves represent the current and the torque in both cases as function of the speed. It is said that with a shunt motor a great deal depends upon the operator, and if cars fitted with shunt-wound motors are to be run on lines having long heavy gradients, the operator must be well trained and reliable, so that he will not injure the motors by allowing the car to travel too quickly and take too much current when ascending these heavy gradients. The author then refers to the difficulty of parallel operation of two shunt motors. These difficulties may arise on account of the different sizes of the two pairs of wheels to which the motors are connected, but they also arise if the field of one motor is slightly stronger than the other. The latter difficulty may be overcome by leaving the field coils always connected in series, no matter how the armatures may be connected. If shunt-wound tramway motors are to be worked with economy, the shunt circuits must be broken every time the car is stopped in order to prevent waste of energy in them, and each time this is done a destructive arc will be produced at the contacts owing to the high self-induction of the coils. Shunt-wound motors can be used for controlling the speed of the car when run-

ning down hill, with the return of energy to the line; this action relieves the wear and tear on the wheels and brake blocks considerably, but puts more work on the motor armatures in just the same way as the rheostatic brake, except that in the latter the energy is wasted in resistances. If shunt-wound motors are to be successfully employed to control the speed of the car in both positive and negative acceleration, their dimensions must be carefully worked out, and the size of the cars and steepness of the gradients on which they are to work must be taken into consideration. When a short-circuit occurs on a section of tramway on which shunt motors are running, it will be very violent, owing to the motor acting as generator and the car circuit-breakers having to open in addition to the station circuit-breaker.—Lond. *Elec. Eng.,* December 1.

Air Brakes for Electric Cars.—BARTHOLOMEW.—A discussion of the variations of an air brake equipment for electric cars, suitable for different methods of car operation. Seven different schedules are dealt with.—*St. R'y Jour.,* December 9.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Municipal Electricity Works.—MUNRO.—His presidential address to the Glasgow section of the (Brit.) Inst. of Elec. Eng. He first deals with general considerations on municipal trading and gives figures on the electricity supply in Glasgow. He then discusses the question whether the production of electrical energy should be combined under one management, distinct from the great departments which have to do with its sale, general distribution, and use for traction, light, power, etc. He thinks that in the smaller towns and in earlier electrical stages of all towns it is economical to combine everything as one undertaking. In the larger cities, however, the work is rapidly becoming so great and varied that in this age of specialists it may be found advantageous to sub-divide and put each department under management which bestows all its study and attention upon one great branch. Arrangements should be made for interchange of information or for a certain amount of combined meeting and action. The author does not think that the removal of electrical generating stations outside of the city to coal fields would be financially advantageous. Refuse destructors are said to be most useful santiary appliances; it is stated that the peak figures at Hackney are 105 kw-hours per ton of refuse, which, at 30 pounds of water per kw-hour, works out at 1.4 pounds of steam per pound of refuse.—Lond. *Elec.,* November 24.

Oil Bath Switchgear.—PUMPHREY.—While the oil is used in transformers primarily for cooling purposes, in switchgear it is employed for quenching any arcs that may be drawn out. Partly, in consequence of this, it sometimes happens that an oil which gives satisfaction with transformers is not suitable for switches. Experience has shown that well built and expensive gear may be completely ruined in a few weeks if unsuitable oil is used for immersing it. The principal impurities to guard against in oil for switchgear are acid, alkali, sulphur, moisture and dust.—Lond. *Elec. Rev.,* November 24.

Electric Station in China.—An illustrated description of a new electric lighting station in Peking. It contains two gas engines of 80 hp running at 140 r.p.m., and driving two direct-current dynamos. The latter are constructed for an output of 110 amperes at 440 to 480 volts, with a speed of 140 r.p.m. In addition to the ordinary commutator, the dynamo has two slip rings connected to the armature windings for use with static balancers, which practically consist of an inductive coil across the two slip rings with the neutral wire connected to the middle. Each dynamo has a separate balancer which will take 25 per cent of the output. "The station has now been running for a year and not the least trouble has been experienced with these balancers, which certainly would not have been the case with rotary ones and Chinese attention." The distribution is carried out on a three-wire system.—Lond. *Elec. Rev.,* December 1.

ELECTROPHYSICS AND MAGNETISM.

Deflection of Alpha Rays.—MACKENZIE.—An account of an experimental investigation. He first studied the magnetic and electrostatic deflection of alpha rays from radium. The value of the ratio of the charge to the mass of an alpha particle from radium was found to be 4,600. Assuming that the charge on the alpha particle is the same as that carried by the hydrogen atom, for which the above ratio is 10,000 in the same units, it follows that a mass of the alpha particle is 2.2 times that of the hydrogen atom or about that of the hydrogen molecule. The author then studied the magnetic deflection of alpha rays from polonium. Under the assumption that the value of the ratio of charge to mass is the same as in the case of radium, he finds that the velocity of alpha particles from polonium is greater than that of those from radium.—*Phil. Mag.,* November.

Theory of Coherer.—BLANC.—A paper in which the author develops an electron theory of the coherer. The author experimented with light pressures produced between a steel plane and a hemisphere, the latter being attached to a lever bearing at its end an armature attracted by an eletromagnet, counterbalanced by a spring. Very light pressures could thus be applied without shock. On increasing the pressure, the resistance diminishes very rapidly at first, and then more and more slowly. On releasing the pressure, the resistance never becomes as high as before, the pressure having increased the adherence. This marked influence of pressure suggests to the author a theory in which diffusion plays the main part. Besides gaseous and liquid diffusion there is also a diffusion of solids in mutual contact, as shown by Barus, Spring and others. A pressure induces this diffusion, and its result is to assimilate the surface layers of the metal to the interior of the metal. In coherence, the pressure is produced by the electric field which induces changes of opposite kinds on the surfaces of two grains facing each other. Now, the interior of a metal contains more free electrons than do the surface layers. The effect of diffusion is, therefore, to give the latter a higher conductivity. The positive ions of the metal would also take part in the diffusion, and the elevation of temperature may aid the transference of ions from one metallic grain to another.—Lond. *Elec.,* December 1; from *Jour. de Phys.,* November.

ELECTROCHEMISTRY AND BATTERIES.

Silicon Alloys.—ALBRO.—The conclusion of his illustrated paper on the microstructure of ferro-silicon and copper-silicon, with notes on the action of silicon towards carbon and silicon carbide. Potter has found that when silicon and silicon carbide are saturated with each other, the resulting material exhibits remarkable properties. Analysis proves this to contain the element and its carbide in proportions approximating very closely the formula $SiC + Si =$ (perhaps) Si_2C. The material is non-porous, harder than corundum, and so tough that a 3-in. tube withstood heavy blows from a sledge on all its faces without fracture. This substance is called carbosilicon.—*Electrochem. and Met. Ind.,* December.

Chemical Effects of Electric Discharges.—Two Bunsen Society papers. The first by Loeb gives a preliminary account of experiments on the synthesis of sugar by means of silent discharges, the other by Brode discusses the effects in the different zones of an arc discharge for the fixation of atmospheric nitrogen.—*Electrochem. and Met. Ind.,* December.

Analysis.—SMITH.—The conclusion of his paper on a coöperative analysis of a copper slag. In the present installment the author deals with the determination of lime, magnesia, manganese, sulphur and zinc.—*Electrochem. and Met. Ind.,* December.

Electrolytic Analysis.—GUESS.—An illustrated paper on the electrolytic assay of lead and copper and on a new and improved form of electrodes for such work in works laboratories.—*Bi-Monthly Bull. Am. Inst. Min. Engs.,* November.

Electrochemistry.—THRELFALL.—The first part of his inaugural address to the Birmingham section of the (Brit.) Inst. Elec. Engs., on some problems of electrochemistry and electrothermal chemistry. In the present installment he discusses the fixation of atmospheric nitrogen and the production of artificial diamonds.—Lond. *Elec.,* December 1.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Spherical Photometer.—BLOCH.—A very long paper on the theory and practice of Ulbricht's spherical photometer which permits to measure the mean spherical candle power of a lamp by a single measurement. The principle is as follows: Within a large sphere, the inside of which is painted white, a source of light is placed in the center, and a certain point of the inside surface of the sphere is chosen which is observed. The light which would fall from this source directly upon this point of observation is screened off so that the point of observation is illuminated only indirectly by the light reflected from the white surface of the sphere. The author first shows mathematically that by a single measurement of the illu-

mination of that point of observation one gets a value which is proportional to the mean spherical candle power of the lamp if this is placed in the center of this sphere. If the lamp is removed from the center to the surface of the sphere so that the radiating center is exactly within the surface, then a single measurement gives a value proportional to the mean hemispherical candle power (the constant of proportionality in the latter case is one-half that in the determination of the mean spherical candle power). These results are derived mathematically by the author. In practice, however, there are two main sources of error. One is due to the lamp not being in exactly the central position in the sphere, the second is due to the solid fittings of the lamp which keep the light of the lamp away from some parts of the inner surface of the sphere. Extended experiments of the author show that the errors from the second source greatly outweigh those from the first one, but that a compromise can be made sufficient for all practical purposes if the lamp is not placed in the center, but is suspended at a distance of from 8 to 15 centimeters from the top of the internal surface of the sphere, the diameter of the latter being one meter. By placing the lamp near the top, the largest parts of the fittings (especially of arc lamps) are then outside of the sphere. Experiments with a great many different sources of light show that the mean spherical candle power can be obtained by this arrangement with an error not higher than about three per cent. The spherical photometer is simply calibrated by first using with the sphere a lamp the mean spherical candle power of which is known accurately.—*Elek. Zeit.*, November 16 and 23.

Street Photometer.—Bloch.—In an article on the Ulbricht spherical photometer the author describes a street photometer by Brodhun. The light of the lamp tested is compared with the light of a small osmium lamp for three volts and 1.5 candles. The current supplied to the osmium lamp from a small battery is kept exactly constant. It has been found that it is better to keep the current constant than the voltage, since in this way no errors are possible from contact resistances. The light coming from the osmium lamp is adjusted by means of a sector device which operates on the law of Talbot. According to this law if the light coming from a certain source is periodically screened off at regular intervals, then the eye gets nevertheless the impression of a continuous light effect if the frequency is high enough, and the apparent candle power of the source of light is then proportional to the ratio of the time element during which light reaches the eye to the total time of one period. The construction of the photometer is shown in Fig. 5. From the osmium lamp, *g*, the light falls on a frosted

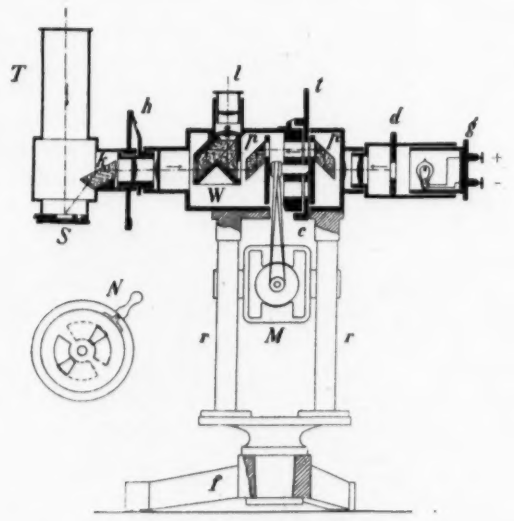


FIG. 5.—STREET PHOTOMETER.

glass disc, *d*, the image of which is enlarged by two lenses and projected upon the prism arrangement, *W*. Before the rays reach *W*, however, they are deviated from their path by two Fresnel's prisms, *p p*. These two prisms are revolved by means of a small motor, *M*, driven by power from a 6-volt storage battery. The light rays deviated by *p p* are also thereby revolved. In their path they meet a stationary and an adjustable sector, shown separately by *N* in the lower left-hand corner of the illustration. According to the position of the adjustable sector, the sector opening may be changed between 0 and 110°, and by adjusting this opening the light which reaches the prism arrangement, *W*, is adjusted. The light of the lamp to be tested falls through the tube, *T*, on a gypsum plate, *S*, from which it is reflected diffusely. The rays which fall on the prism, *k*, are reflected in the direction of the axle of the whole apparatus, and are concentrated by a pair of lenses on the prism arrangement *W*. The comparison of the two lights takes place by means of the magnified glass, *I*, which is shown in the illustration in a vertical position, but is in reality horizontal. The tube, *T*, through which the light from the lamp to be tested goes into the apparatus, may be revolved around the main axle of the photometer so that the candle power of the lamp may be taken in any direction.—*Elek. Zeit.*, November 16.

White Walls in a Photometric Laboratory.—Hyde.—Dead black walls for photometer rooms are somewhat of a hardship. The author remarks that white walls with a protection of the photometer by black diaphragms are at present in use to some extent in the photometric laboratory of the German Reichsanstalt. A similar arrangement has been adopted in a room of the Bureau of Standards in Washington. The photometer is placed near the middle of the room and is supplied with a set of diaphragms covered with black velvet. These diaphragms may be so arranged for any position on the bar that no light, except that reflected from the lamps under test or from the diaphragms themselves, can reach the photometer screen, as shown by the accompanying sketches. Fig. 6 is a hori-

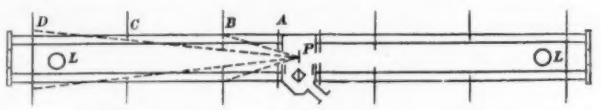


FIG. 6.—HORIZONTAL SECTION OF PHOTOMETER.

zontal section of the photometer through the center of the Lummer-Brodhun sight-box, showing the arrangement of diaphragms, *A, B, C* and *D*. Elevations of these diaphragms perpendicular to the axis of the photometer are given in Fig. 7. By reference to Fig. 6 it is seen that an eye placed at *P* could see nothing but black

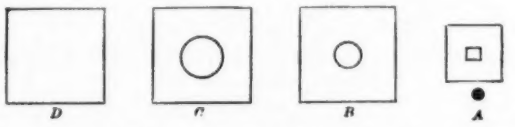


FIG. 7.—PHOTOMETER DIAPHRAGMS.

velvet diaphragms and the lamps under test. Conversely, no light could reach the screen except from the lamps or from the diaphragms. Special tests have been made to determine the magnitude of the errors resulting from reflected light from the white walls of the photometer room. The results of these measurements show conclusively that the error is entirely negligible. It is, however, entirely desirable to exclude daylight by curtains. The error due to the light reflected from lamps on the walls is negligible in the most refined measurements.—*Buil. Bureau of Standards*, No. 3.

"Voltascope."—Thornton.—A note on a simple apparatus, the purpose of which is to indicate the state of charge on cables in order to see whether they are safe to handle. The instrument as it is now made consists of a glass tube containing oil and short fine carbon rods. Contact is made across the mains through a heavily-insulated wire having an ebonite or fibre handle with sharp steel points to get good contact. It works equally well with direct and alternating-currents, and in any position. As soon as contact is made the carbon filaments become polarized and form an irregular chain, along which a small current passes, jumping across minute gaps between the particles, and so forming sparks which are instantly extinguished by the oil, their constant appearance and extinction giving the tube the effect of scintillation.—Lond. *Elec.*, November 24.

High-Tension Voltmeter.—Thornton.—A note on a high-tension voltmeter which differs from other forms in the use of a dielectric needle or quadrant. A short ellipsoid of paraffin or sealing wax is suspended by a fine silk or quartz thread between brass plates, contained in a glass globe about 15 cm. diameter. Theory indicates that the torque on the suspension is proportional to the square of the voltage, and experiments prove this to be true. The instrument is used in the same way as the Siemens dynamometer or the Aryton-Mather voltmeter of the same type. The ellipsoid is brought to a balanced position between stops by rotating the torsion head. The lowest voltage to which it is sensitive is about 500, and the

author has used it to measure spark-gap voltages up to 100,000. Since specific inductive capacity varies with frequency, a simple correction must be applied for this.—Lond. *Elec.*, November 24.

Measuring Permeability.—THORNTON.—The permeability of iron may be measured by the torque on a long ellipsoid, suspended in a magnetic field, and in the same manner this instrument enables one to determine the dielectric constants of all solids, liquids or gases when a litre of the latter can be obtained. The effect is a function of the relative permittivities of ellipsoid and medium, and a comparative series may be readily formed and checked by reference to air. The fact that the results are comparative, and that the zero position of the moving system is the same for all, enables one to work with considerable accuracy. The ellipsoids must be made very carefully. The author remarks that the microscope might be much more used in electrical engineering than it is at present, if, indeed, it is used at all. It is known now that the permeability of iron depends upon the size and distribution of the crystals of carbide of iron in the metal, and that these are changed by the heat treatment this has received. He therefore suggests to estimate permeability by polishing a surface on the metal, observing it through a microscope, and, if necessary, photographing it. After a time, by collecting a set of standards, the quality of any specimen might be assigned in a few minutes by inspection.—Lond. *Elec.*, November 24.

Disturbances from Tramways on Testing Laboratories.—MAURAIN.—A discussion of the disturbing influences which neighboring electric tramways have on electric and magnetic measuring instruments.—*La Revue Elec.*, November 17.

Measuring Self-Induction by Weighing.—ZIPP AND PEUKERT.—Two communications with respect to Peukert's method described in the Digest of October 28 (page 743) for determining the self-induction by means of weighing. Peukert corrects the formulas given in his former article. The coefficient of self-induction is

$$\frac{R^2C}{1+\omega^2C^2R^2}$$

and approximately R^2 C, if the value of the denominator is nearly unity; the meaning of the letters being the same is in our former abstract.—*Elek. Zeit.*, November 23.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Long-Distance Telegraphy in Australia.—HOWARD.—Some accounts of experiments of carrying on long-distance telegraphy almost around the whole of Australia. The messages were transmitted from Cape York to Broome for 15 minutes at the key speed of 20 words per minute without the least sign of lag in the signals. There were 13 repeating stations and the total length was more than 6,600 miles.—Lond. *Elec.*, December 1.

Commercial Wireless Telegraphy in Germany.—FOURNIER.—Some notes on the commercial organization of wireless telegraphy in Germany. The terms radiotelegram (wireless telegram) and radiotelegraph (wireless telegraph) are mentioned. Stations have been established along the coast to transmit messages over a distance of 200 km. between themselves, and over a distance of 120 km. with ship stations, the height of the mast being 30 meters. The length of the waves emitted by these stations is 365 meters. Some notes are given on the signal codes employed.—*La Nature*, November 11.

MISCELLANEOUS.

Electrical Progress.—PEARCE.—His presidential address to the Manchester section of the (Brit.) Inst. Elec. Engrs. He gives a concise review of recent electrical progress. He first deals with the new types of lamps and says that "the application of the intensified or high-pressure system of gas lighting has found favor in many quarters, and is a competition that has to be seriously faced." He expects a more extended use of flame arcs from the successful development of the magazine lamp; a magazine to contain sufficient carbons to obtain 50 hours of burning. Notes are given on progress in electric traction and central station supply. The author says that central station engineers are gradually coming to recognize more and more the value of steam turbine plants, and that the gas engine has hitherto found little favor for central station work in England, and is not likely to oust the steam turbine. The conditions which militate against the adoption of gas plants for large power stations as compared with turbine plants are summarized as follows: (1) The higher initial capital outlay. Taking a station of from 20,000 hp to 30,000 hp, gas plants could not be installed for less than $90 per kilowatt, exclusive of buildings. A modern steam plant could be put down for two-thirds of this amount, and in fact a figure of $40 has been taken in one notable instance. (2) Increased floor space required. (3) Probable higher rate of depreciation and increased maintenance costs. Against this the following advantages of producer gas plants are mentioned: (1) The saving in actual fuel, which, of course, varies under different conditions, but is not likely to be less than 15 per cent to 20 per cent. (2) The saving due to the recovery of the sulphate of ammonia. The combination of the latter, however, with high-tension plants is not one that commends itself to electrical engineers.—Lond. *Elec.*, November 24.

Swedish Association of Electrical Engineers.—Some notes on the recent first annual meeting of the Swedish Assoc. of Elec. Eng. held in Stockholm. Prof. Wallin, the president, and 275 members were present. Papers were read by Ericson on high-tension installations, by Norberg on insulation and voltage rises in transmission lines, by Andreen on the operation in parallel of hydraulic stations at great distance from each other and by Holmgren on tariff and meter problems.—*Elek. Bahnen*, November 14.

Education and Research.—THORNTON.—His presidential address to the New Castle Section of the (Brit.) Inst. Elec. Engs. The author first discusses the science and art of engineering and the education of engineers. He then emphasizes that research is a good investment and gives examples showing that "one never knows to where an experiment a little off the beaten track will lead."—Lond. *Elec.*, November 24.

BOOKS RECEIVED.

GAS ENGINE DESIGN. By Charles Edward Lucke. New York: D. Van Nostrand Company. 254 pages, illustrated. Price, $3.00 net.

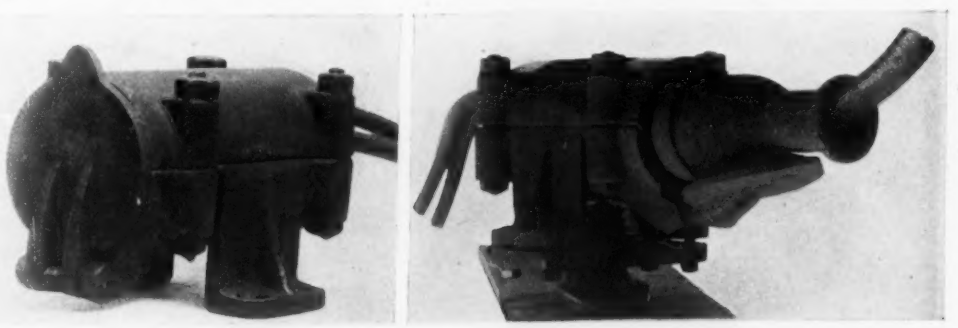
STEAM TURBINES. With an Appendix on Gas Turbines and The Future of Heat Engines. By Dr. A. Stodola. New York: D. Van Nostrand Company. 434 pages, 241 illustrations. Price, $4.50.

EXPERIMENTAL RESEARCHES ON THE FLOW OF STEAM THROUGH NOZZLES AND ORIFICES. By A. Rateau. New York: D. Van Nostrand Company. 76 pages, illustrated. Price, $1.50 net.

HANDBUCH DER ANGEWANDTEN PHYSIKALISCHEN CHEMIE. Vol. I: Electrochemie Wasseriger Losungen. By. Dr. Fritz Foerster. Leipzig: Johann Ambrosius Barth. Vol. I, 507 pages, 121 illustrations. Price, 20 marks. Vol. II: Physikalisch-Chemische. By Dr. C. Doelter. Vol. II, 272 pages, 66 illustrations. Price, 12 marks.

Charging Receptacles.

The extensive use of electrically-operated vehicles and the varied application of storage batteries for train lighting, small electric locomotives, storage battery cars, etc., has created a demand for convenient and durable accessories, one of the most important being a charging receptacle that will withstand hard usage and can be handled without danger of short-circuiting the line when inserting or removing the plug. With this idea in mind the Westinghouse Electric & Manufacturing Company has developed and placed upon the market a charging receptacle shown in the accompanying illustration.



FIGS. 1 AND 2.—CHARGING RECEPTACLE.

It consists of a cast metal case, circular in form, and occupying a

minimum amount of space. Within the case are suitably mounted contacts for receiving the plug. A hinged lid at one end, held normally closed by a coiled spring, affords access to the interior. The receptacle being entirely enclosed effectually protects it from dirt and water. The plug and contacts within the receptacle are so designed that it is impossible to cause a short-circuit when inserting or withdrawing the plug.

The receptacle may be provided with a swivel attachment, conforming to standard railway practice, which is a decided advantage as it admits the pulling out of the plug when the vehicle or car starts, the receptacle swinging in line with the cable, and allowing the plug to pull out without danger of breaking the cables or contacts. The construction is rugged and all parts well made, thus insuring a long period of service.

Steel Tower Pole Line.

The Hudson River Electric Power Company, of Albany, N. Y., which is constructing a 60,000-volt transmission line from Ballston to Utica, via Amsterdam, has introduced an innovation in the way of steel tower lines, doing away with the old-style wooden poles.

The towers are to be 50 ft. high and will consist of structural iron or steel. The foundations will be made of concrete and crushed stone and bolts will be set in the same, to which the base of the towers will be bolted. They will be set about 550 ft. apart, or 10 to the mile, and will be so arranged that two three-phase circuits can be carried on the same.

The security of this system is very marked, as the towers are not affected by lightning discharges. Special towers are being designed for long crossings and for river work.

The first of these towers will be tested in the Power Company's testing yard at Watervliet, in a few days and, after receiving the engineers' approval, the work will be started at once, on the line extending from Ballston to Amsterdam, and from there to Utica.

The American Electrical Salesmen Association.

Mr. Vincent Gray, the president of the American Electrical Salesmen's Association, with headquarters at Washington Street, Chicago, sends us the subjoined communication:

Only a few months ago the "Field-men" of the electrical interests got together in the city of Peoria while attending a convention of the Illinois State Electrical Association, and organized what they chose to name the American Electrical Salesmen's Association. The few present agreed that the purpose of the organization should be: 1st, Fraternalism. 2d, Uplifting of the standard of salesmanship. 3d, The general advancement of electrical interests. Since then the question has been continually asked: "What is your purpose?" and I have been asked to set forth in this article, "Our Purpose."

Everybody recognizes that up to a few years ago the electrical interests were far from the standard of other commercial and professional vocations. Every branch of the business seemed to be on "one grand spree," metaphorically speaking, and this is easily accounted for when considering the fact that it was more or less in an experimental stage. Now that the public in general has joined the parties at interest in the faith of its stability—like the school children after a recess—electrical interests have settled down and are "hard-at-it."

Thus the business is organized. The "Field-men" have played no small part, as I believe will be admitted, in this result coming about as quickly as it has, yet, they, as a body, have had no organization; consequently have drifted along with the "current of time," taking matters just as they came. Now, they have come out of their "Rip Van Winkle sleep," and have organized, and their purpose is strength.

If, as we propose, we can harmonize or fraternize, we have accomplished the second and third clauses in "Our Purpose"; for in fraternizing we uplift the standard, and in uplifting our standard, the interest of the electrical business in general is undoubtedly advanced.

I believe I am not stretching a point when I say the electrical field-men, as a whole, are above any other class of men constantly on the road; and it is a noticeable fact that their conduct at all times is governed by the consciousness that they are the representatives of their employer and have no desire to blot the escutcheon of their concern.

We are not a union in the sense the word is commonly applied. We are not banded together to discuss the methods of the firms we are connected with, but we purpose at our meetings to bring up such matters as will be to our mutual interest, and discuss them. Again, we hope from time to time to have "Lights" in the business appear before us and give us talks on such subjects as can be appropriately addressed to us. We feel that this opportunity will be sought after when we are well under way, if not now.

We have in mind, too, that through our organization we can keep in touch with "our friends" in the business, which we are unable to do at this time; and this same purpose affords the employer the opportunity to do likewise.

We also believe that we can help members out of position to obtain employment, and it is understood that such members can file their names with the secretary, who will answer correspondence from those seeking men.

I have briefly outlined "Our Purpose," and if this association will make more efficient salesmen and beter citizens through its influences, it will have succeeded in elevating commercial interests generally. At our meeting, at Chicago, January 20, 1906, more specific information will be outlined. Those who are eligible will find it materially to their interest to file their application with the secretary.

The Trolley at Leith, Scotland.

An interesting trolley equipment has recently been made at Leith, Scotland. The authorities of Leith purchased last year from the Edinburgh Street Tramways Company the horse tramways in Leith. These tramways were the portion of the Edinburgh Street Tramways Company's property in the burgh of Leith. The greater part of this company's lines were originally in Edinburgh, but about the year 1892 the corporation of Edinburgh purchased the lines in that city, and about 1896 converted them for cable traction. Since that time there has been a break in traffic at Pilrig Street, the boundary between Edinburgh and Leith, and passengers have had to change from the cable into the horse cars. The Edinburgh officials are still sticking to the antiquated cable, but the Leith authorities have electrified right up to the boundary, and have put in about 6½ route miles of trolley with side and center bracket construction.

The number of types of the cars is as follows: Ordinary double-deck, thirty, and covered top double-deck, six, making thirty-six cars in all. The contract was equally divided between the British Thomson-Houston Company and the Brush Electrical Engineering Company, each supplying fifteen ordinary double-deck cars and three covered top cars.

Two types of cars were supplied by the British Thomson-Houston Company, of Rugby, and they differ from those supplied by the Brush company. The bodies and trucks were made at Preston at the United Electric Car Works. The over-all length of the bodies is 27 ft. 6 in.; the over-all width, 6 ft. 9 in., and the height from the rail to the trolley plank, 9 ft. 7 in. on the double-deck cars and 15 ft. 8 in. on the covered top cars. Each has four side windows. The seating capacity of the double-deck cars is twenty-two inside and thirty-six outside, a total of fifty-eight; and of the covered top cars, twenty-two inside and thirty-four outside, a total of fifty-six. The trucks are Brill 21-E type with wrought-iron center wheel with steel tires 31¾ in. diameter, made by John Baker & Co., of Rotherdam. The wheel base is 6 ft.

The equipment consists of two motors, General Electric 54 type, with four-turn armatures, two controllers of the B-18 type, with rheostatic brake of five notches, with the necessary resistances, circuit-breaker, fuse, lightning arrester and trolley earth indicator, etc. On the ordinary double-deck cars there are eighteen 16-cp incandescent lights, and on the covered top cars, twenty-two lights. The covered top cars have sash side windows and sliding panels on the roof similar to those at Liverpool. The system is also supplied with one training car, which is equipped with B. T. H. type General Electric 54 motors and B-18 controllers, and one water cart and sweeper combined, equipped with General Electric 58 motors and B-18 controllers. All the equipments are double-motor.

The Brush cars, made at Longborough, have an over-all length of 28 ft., width 6 ft. 9 in., with a seating capacity of 22 inside and

34 outside, for the double-deckers. The covered top cars carry 22 inside and 32 outside. The motors are Brush and the equipment includes Garton lightning arrester and trolley earth indicator.

The New York Electrical Show.

The Madison Square Garden Electrical and Mechanical Show, which has been in progress since December 12, ends this week. For the purely technical mind in search of something new, the exhibition had little to offer; but for the general public, which is concerned with the more popular electrical apparatus that is rapidly adding to the comforts of home life, the show has had much of interest.

The opening of the exhibition was made auspicious by the fact that President Roosevelt used the Greeley gold telegraph key in the act formally inaugurating the show. The key was made by the late firm of E. S. Greeley & Company, of which General E. S. Greeley, of New Haven, Conn., was president, and through whose courtesy the key was loaned to the management for the opening ceremonies. The key was first used by President Cleveland for the World's Fair, Chicago, 1893, and again by Governor Morton for the Electrical Show of 1896, by President McKinley for the Electrical Show of 1898, and by President Roosevelt for the St. Louis Exposition, 1904.

The exhibit of the New York Telephone Company situated in the main aisle formed the central atraction of the show. The exhibit consists of a working telephone exchange, which is typical of the private exchange system of supplying telephone service which is in such general demand. To the switchboard, situated in the company's exhibit in the center of the Garden, are connected lines running to telephone stations in the spaces of exhibitors. No charge is made for messages sent between telephones inside Madison Square Garden. A "theatrophone" installation is a part of the exhibit and at certain hours the popular musical attractions of the city theaters are transmitted by telephone and may be heard by visitors without charge.

The American De Forest Wireless Telegraph Company exhibited a portable wireless telegraph outfit and a wireless signal equipment, such as was used by the Japanese during the late war.

Felix Hamberger, New York City, had on exhibition twelve Siemens flame arc lamps, which attracted much attention. The lamps burned with a golden yellow, red, brilliant white and other colors, according to the carbons used, the carbons being impregnated with the coloring material.

FIG. 2.—NEW YORK TELEPHONE COMPANY'S EXHIBIT.

The Gold Car Heating and Lighting Company, New York City, showed by actual demonstration the practicability of the adaptation of electricity to the heating of cars and buildings. Typical pieces of electric heating apparatus were on exhibition.

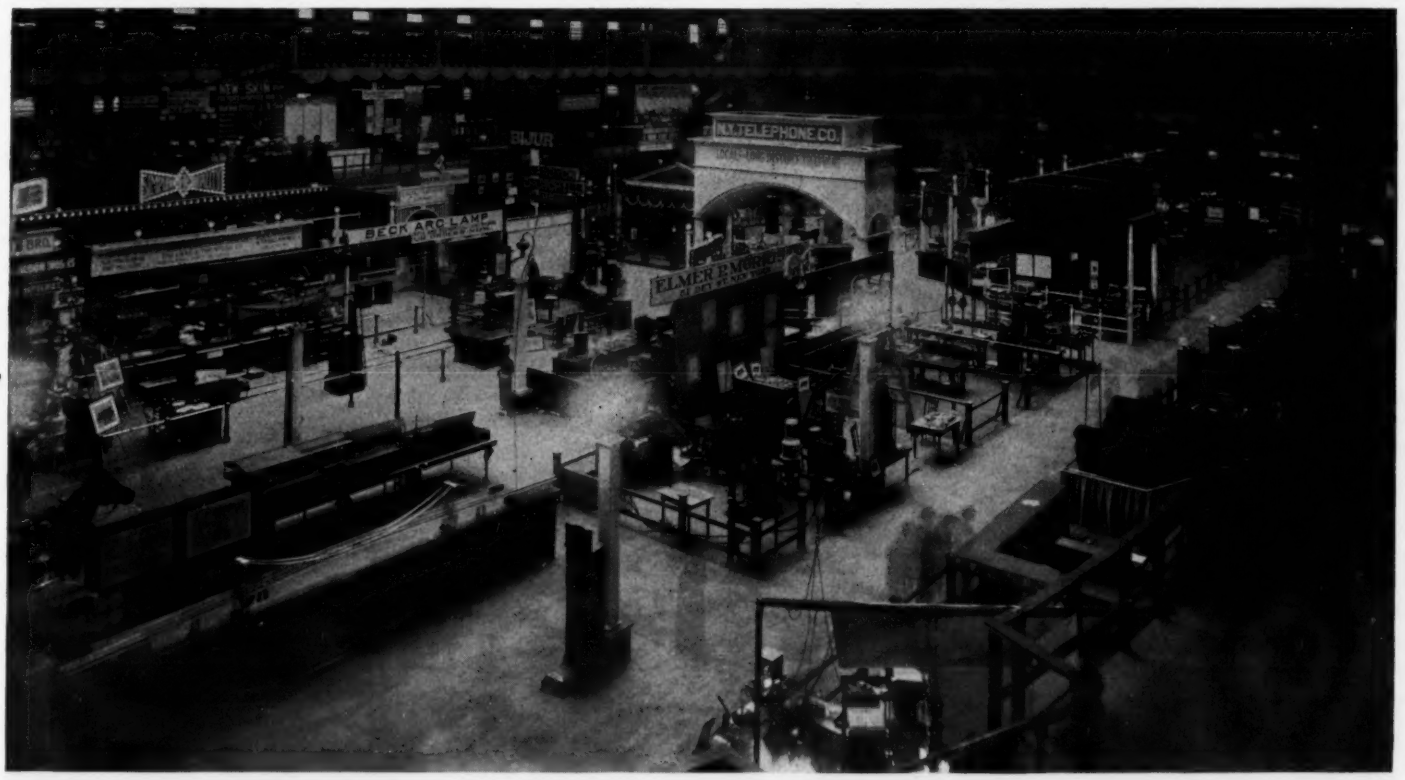


FIG. 1.—GENERAL VIEW OF ELECTRICAL SHOW, MADISON SQUARE GARDEN, NEW YORK.

The Vandyck-Churchill Company, New York City, showed a geared head lathe which it is claimed will do three times the work of a cone-driven lathe. A motor-driven saw fitted throughout with steel or bronze gears and a 4-ft. arm plain radial drill completed the outfit. All of the machines were in operation demonstrating the advantages of motor-driven tools.

The Kinsman Block System Company, New York City, had a working exhibit of its protective train apparatus, such as used in the New York Subway. A short section of track was equipped with guard rails and switch, and a full size semaphore and brake equipment. The automatic shutting off of power and the instantaneous application of air brakes, when for any reason a train entered a danger zone, was shown by actual demonstration.

The Kinsman Electric Railway Supply Company, New York City, exhibited the phonoscopic or electric detector by means of which station managers or others interested in electric light work may be kept informed of the condition and operation of the wire circuits, generators, etc. The device is said to be applicable to street railway work for detecting defective motors on the line. The auxiliary car-lighting system of the company was also on exhibition. The apparatus consists of a number of lamps, a storage battery, a charging switch and an automatic change-over switch. When the current is shut off for any reason, the change-over switch places the lamps and battery in circuit so that the cars are never without light. When the current is again turned on, the battery and auxiliary light are automatically cut out of circuit.

The Wireless Electric Company, of Philadelphia, Pa., showed a working model of the Pullen surface contact system of electrical propulsion, and also an electric battery and new type of arc lamp. The operation of the surface contact railway was shown by a miniature railway car running back and forth on a trestle, and a mining locomotive utilizing the same system was also shown in operation on tracks on the floor.

Holcombe & Company, New York City, had an interesting exhibit of electrical supplies and novelties.

Waterbury & Company, New York City, made a very interesting exhibit and one of the largest in the show. Mr. Francis Granger designed the exhibit, in the center of which was the complete switchboard for the New Harlem Hospital, which will be installed at the close of the exhibition. This is a seven-panel board of white marble with copper finished instruments. The company showed a complete line of rubber-covered wire, lead-covered telephone wire, several varieties of manila rope, a complete line of panel boards, new switchboard wire, flame proof wires, etc. The space was enclosed in a marbleized fence, each upright being different and made of a section of the company's lead covered cables; a large knife switch was used as a bar across the doorway. A number of the company's new switches were on exhibition. The demonstration of the marbleizing process attracted much attention. Paints of different colors were floated in a tank of water and manipulated so as to obtain the veined effect of marble; when the proper effect was obtained a piece of board was placed face downward on this floating paint for an instant and then removed and dried by electricity. This simple method of obtaining an imitation marble naturally elicited favorable comment. Mr. T. J. Murphy, the company's switchboard engineer, and about a dozen salesmen were in attendance.

The Electro-Dynamic Company, New York City, had as a feature of its booth an "interpole" motor driving a similar machine as a dynamo, the current being used to light the sign over the booth. Demonstrations were given showing how the motor stood up under a 100 per cent overload without sparking even when instantly reversed under overload. Messrs. Peck, Bell, Van Doren and Neefus were in attendance.

The Moloney Electric Company, St. Louis, Mo., occupied the same booth as the Electro-Dynamic Company. Four sizes of Moloney transformers were on exhibition. Mr. J. J. Mullen of St. Louis was in charge.

Caldwell & Ousterhoudt, New York City, manufacturers' agents, made an exhibit displaying products manufactured by the companies they represent. The Century Electric Company, of St. Louis, Mo., showed a self-starting single-phase motor; the American Vibrator Company, St. Louis, Mo., exhibited a vibrating machine for massage work; the Crescent Electrical Manufacturing Company, of Rochester, N. Y., displayed a line of panel boards, knife switches, and electrical specialties, and the Kirkpatrick Manufacturing Company, of Philadelphia, Pa., a new "self-wiring" moulding.

The Standard Vitrified Conduit Company, New York City, had an exhibit of its product in charge of Mr. B. S. Barnard. The Philadelphia Electric and Manufacturing Company also exhibited a line of its specialties in the same enclosure.

The Brunswick Refrigerating Company, New Brunswick, N. J., showed two of its electrically-driven refrigerating machines in actual operation, and they naturally called forth much comment. The advantages of the outfit over the ordinary ice-box were pointed out. It not only acts as a refrigerator but also manufactures ice in small quantities for the table. The outfit requires little attention, occupies but a small space, and the cost of maintenance is said to be slight.

The Prometheus Electric Company, New York City, showed a complete line of electric heaters and cooking utensils in operation, and the booth was a center of attraction for those interested in electric cooking. The ease and rapidity with which meals could be prepared by electric cooking utensils were clearly demonstrated.

The George L. Mason Company, New York City, occupied a booth near the door, where the "Mason" jewel signs were on exhibition. The jewels may be of any color, and by using varied colored lamps in the box, beautiful effects were produced. The large changeable signs on the Fourth Avenue wall of the Garden were installed by the Mason Company. The exhibition was in charge of Messrs. G. L. Mason, D. McCullagh, F. Sutton and W. H. L. Edward.

The Niagara Tachometer & Instrument Company, Niagara Falls, N. Y., displayed a very complete line of hand-spring tachometers, bi-fluid tachometers and bi-fluid tachographs. The bi-fluid tachometer consists simply of a containing vessel holding two liquids, one the lighter and indicating liquid resting on the heavier liquid —mercury. The operation of the instrument depends upon the action of centrifugal force. As the instrument is hermetically sealed after calibration, there is no evaporation of the indicating liquid. The tachograph, or recording tachometer, is based on the same principle, a pen recording directly from the mercury upon a rotating drum which is operated by clock work. The exhibition was in charge of H. A. Hageman and R. H. Hendrick. A number of instruments were shown in operation.

The Clark Electric Manufacturing Company, New York City, displayed a number of its clamps for high-tension transmission lines. Numerous forms of interlocking and underlocking clamps, copper splicing sleeves for splicing hard-drawn copper wires and cables, angle locking insulator clamps, and ball-and-socket insulator clamps were shown. Clamps of this description are used on the transmission lines of the Mexican Light & Power Company, Necaxa, Mexico, Transmission System, Guanajuato, Transmission System, Durango (Colo.) Transmission System, Winnipeg (Ont.) Transmission System and the Rio de Janeiro Transmission System. The booth was in charge of Messrs. Wilson, Clark and White.

The Stow Manufacturing Company, Binghamton, N. Y., had a working exhibit in charge of Mr. R. Pollock, assisted by C. S. Netzorg and C. F. Hotchkiss. An example of the use of the Stow multispeed motor for driving a printing press was clearly demonstrated, and in addition to this, there were on exhibition the electric hand drills, electrically-driven emery grinders and motor-driven flexible shafting built by the company.

The Enos Company, New York City, occupied a large space in which were exhibited gas and electric fixtures and portables of the very latest and most artistic designs, and also of the finest workmanship. These fixtures called forth much favorable comment.

The Chicago Pneumatic Tool Company, Chicago, Ill., had in operation a number of air-cooled Duntley electric drills of different sizes for drilling holes from the smallest up to 2½ or 3 in. diameter in iron or steel. The exhibit also included "Little Giant" storage batteries for automobile and power purposes, and also storage batteries for internal combustion engines particularly adapted to automobile service. The exhibition was in charge of Thomas Aldcorn, general sales agent. Mr. Aldcorn was assisted by Messrs. C. B. Coates, A. B. Innes and W. J. Blake.

The American Electric Novelty & Manufacturing Company, New York City, had a large space in the main aisle, where it had on exhibition hundreds of different electric novelties. Among these were pocket search lights, electric cigar lighters, electric stick pins, medical batteries, electric candles and candelabra, watch stands, gas lighters, electric Christmas tree outfits, etc.

The Peerless Electric Company and Magnet Wire Company, New York City, exhibited an interesting line of electric specialties. Among these were an electric vibrator for use in massage treatment.

The National Battery Company, of Buffalo, N. Y., had on exhibition a number of National storage batteries with all their accessories.

The Gray National Telautograph Company, New York City, at-

tracted much attention. The telautograph was shown in operation, transmitting writing in its original form instantaneously and secretly.

The Tacony Iron Company, Philadelphia, Pa., had on exhibition the Franklin turbine pump, which was direct-driven by a Westinghouse electric motor. The pump is particularly adapted for use as a house-tank pump, requires but little attention, and the cost of operation is slight.

The General Storage Battery Company, New York City, had on exhibition a number of Bijur "high-duty" storage batteries. There was shown a miniature application of the Bijur high-duty storage battery absorbing fluctuations of variable loads as used for electric elevators, electric hoists, etc. There was also shown a generator charging a F-15 cell and also supplying current to the line. A load in excess of 2,000 amperes was suddenly thrown on the line, and almost the entire fluctuation was taken by the storage battery, the generator load not increasing more than 10 per cent. A number of Bijur cells were on exhibition, as well as a charging booster, a standard battery case for railway signals, constant-current booster, yacht-type switchboard, yacht lighting battery, main switchboard for controlling the motor booster and field currents for two motor-driven booster sets, etc. The exhibition was in charge of the office force of the General Storage Battery Company, presided over by General Sales Manager J. B. Cowen.

The Electro-Radiation Company, Boston, Mass., had in operation X-ray and electro-therapeutic apparatus. The use of this apparatus for the treatment of various diseases was demonstrated.

The Simplex Electric Heating Company, through its New York representative, Roger Williams, displayed what was probably the most complete line of electric heating and cooking appliances ever shown at an exhibition. The display included smoothing irons of all sizes, chafing dishes in six or more different designs, curling iron heaters, heating pads, nursery milk warmers, water cups for boiling water, stoves of all sizes from 4½ to 15 in., ovens of four different designs in which biscuits were baked and meats roasted, glue pots of all sizes, soldering irons, radiators, hair driers, electric ranges, griddles, and waffle irons. The use of almost every article on exhibition was demonstrated in a practical way, and the whole display proved of great interest to the visiting public.

The Clifton Manufacturing Company, Boston, Mass., had a booth in which various sizes of Clifton conduit were shown.

Charles E. Dressler & Bro., New York City, made an exhibit which comprised some interesting features. The specialty of the concern is experimenting on scientific problems, the development of inventions, the making of models of patentable machines, devices, etc. Models of some notable pieces of electrical and mechanical apparatus were among the exhibits.

The Eastern Carbon Works, Jersey City, N. J., exhibited their Atlantic dry cell, Eastern dry cell, battery connectors and carbon specialties in general. The pocket flash lamp manufactured by the company was also shown. The dry cells are made up in various forms for different classes of work, such as telephones, electric bells, annunciators, gas lighting, etc.

Waite & Bartlett Manufacturing Company, New York City, exhibited examples of the electro-therapeutic apparatus built by the company. The larger motor-driven influence machine attracted the attention of almost every visitor to the show. The X-ray coil exhibited had combined with it a Tesla high-frequency apparatus for the treatment of various skin diseases and cancers.

Charles A. Thompson Company, New York City, representing the St. Mary's Incandescent Lamp Company, of St. Mary's, Pa., and the Sun Porcelain Company, Trenton, N. J., made an interesting display of electric specialties and incandescent lamps. In the same space were exhibits of McLeod, Ward & Company, Atlas Electric Manufacturing Company and W. E. G. Mitchell, all of New York City.

The "Navalite" Conduit Company, New York City, occupied part of the booth of the C. A. Thompson Company, where it had a bootblack dressed as a sailor who polished the shoes of visitors free of charge.

The National Meter Company, New York City, had on exhibition a 50-hp multiple cylinder Nash gas engine of the self-oiling enclosed type, direct-connected to a 30-kw C. & C. generator, the output of which was consumed by the incandescent lamps used in the sign over the booth. The U. S. ignition outfit, built by the U. S. Battery Company, New Rochelle, N. Y., was used in connection with this exhibit.

The Magneta Company, New York City, exhibited a complete line of Magneta electric clocks. A number of clocks about the Garden were all operated from and controlled by a master clock located in this booth.

The National Carbon Company, Cleveland, Ohio, exhibited a complete line of primary batteries and carbon products. The new "Columbia" igniter cell for automobiles and ignition work, the "Stand By," "Globe," "Laclede," "New Century," "Hercules," "Solar," "Ravenna" and "Columbia" signal dry cells, and the "Trojan," and National "Fuller" wet cells were on exhibition, as well as flash lights, carbon brushes, arc light carbons, specialties, etc. A special feature of the exhibit was the Hallberg expansion pigtail brush attachment, which was described in these columns some time ago. The exhibit was in charge of Mr. A. E. Carrier and Mr. A. C. Henry.

G. M. Gest, New York City, occupied a booth with the H. B. Camp Company and the American Vitrified Conduit Company, where a number of different kinds of conduit were displayed, and photographs of a number of subways constructed by Mr. Gest throughout the country exhibited.

Dossert & Co., New York City, exhibited a complete line of Dossert connectors, which attracted the attention of electric contractors and central station men.

The Safety Electric Elevator Company, New York City, had on exhibition a miniature elevator. The elevator machine is bolted directly to the platform of the car and consists of a horizontal drum revolved by an electric motor. On the periphery of the drum is fitted a spiral track which engages and travels on two series of rollers set in the guide posts. The motor causes the drum to revolve, and the car ascends or descends according to the direction of rotation of the motor. The exhibit was in charge of Messrs. E. Schroenkeisen and M. J. Kane.

The American Telegraphone Company, New York City, had in operation a number of Poulsen telegraphones in charge of Mr. W. M. Miner and Mr. S. Rodgers. The instrument records and reproduces the most delicate sounds. The record is made upon a fine wire or thin disc by passing the wire or disc between electromagnets whose intensity varies with the intensity of the telephonic current, and while this magnetic record is of great permanency it can be immediately "wiped off" by passing the record between the poles of a small magnet. The telegraphone may be used for every duty ordinarily assigned to the phonograph and possesses an advantage over the latter in that the dictator need only be in telephonic communication with the apparatus. A number of special applications of the telegraphone were explained during the show.

The Cooper Hewitt Electric Company, New York City, had two converters in operation changing alternating to direct-current for charging a set of storage batteries, as well as a number of mercury-vapor lamps of both the direct and alternating-current types. The exhibit was in charge of Mr. A. S. Hubbard, assisted by Messrs. J. P. O'Shea, C. W. Denny, W. A. D. Evans and F. C. Chapman.

The Sarco Company, New York City, exhibited two flame arc lamps of German manufacture. These arc lamps, for which it is the American agent, use impregnated carbons having a wire core. Either a white, deep red, or golden yellow light is produced, according to the grade of carbon used. The lamps burn two in series on either direct or alternating-current, and use either 8, 10 or 12 amperes according to the volume of light desired. The 10-ampere lamps give approximately 3,000 hemispherical Hefner candle-power, and naturally make an extremely efficient form of illumination. The mechanism of the lamp is of simple and durable construction, and the carbons are placed at an angle and feed downward. The lamp is provided with an automatic cut-off, which cuts the lamp out of circuit when the carbons have reached their limit of consumption. The casings are waterproof and the lamps are furnished with or without enameled iron reflectors. The carbons burn from ten to seventeen hours, according to their length, the carbon consumption being about 1 in. per hour.

William Green & Co., New York City, exhibited a number of electric lathe motors for polishing, buffing, drilling and grinding; also electric clocks and electric chimes.

The Street Cleaning Department of the City of New York, exhibited a complete working model of the light refuse crematory, or rubbage incinerator, which was recently described in these columns. In connection with this exhibit there was also a model of the Williamsburg Bridge.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The principal feature was the holiday trade, which surpassed all records. This activity in specialties, however, showed little effect in the movement of staples, and in jobbing and in manufacturing departments there are unprecedented preparations for the spring season. Little machinery is idle and the outlook for the future is brightened by several announcements of higher wage scales to become effective Jan. 1. The reports coming from the iron and steel industry are gratifying. New business continues to come forward, raising the rate of production above all previous records, while conservatism prevails as to quotations. The demand for finished products continues undiminished, particularly for structural material. Some Western mills have their entire rail production of 1906 already sold. Cars are still scarce, especially in the iron, lumber and grain trade, from which loud complaints are made. Basic conditions of the textile markets are still sound because production shows no indication of surpassing requirements. Money is still in active demand, with somewhat easier rates and collections are irregular, varying with weather and transportation conditions. November export trade, despite its being a short month, is second only to December, 1903, in the value of total shipments. This is caused by the long awaited expansion in breadstuffs, which furnish the entire gain shown in exports over November a year ago. November, 1905, exports exceed October, 1905, by 10 per cent and November, 1904, by 7.8 per cent. Imports show a decrease from October, but a small gain—3.7 per cent—over a year ago. For eleven months exports, imports and total foreign trade exceed all previous records for that period. November gross railway earnings show a gain of 8.6 per cent for 1904, following a gain then of 9.9 per cent of 1903. The great strength of copper prices is the subject of much interest at the present time. Prices in New York are 18½ and 19 cents for Lake copper. Sales of small lots were reported to have been made for immediate delivery at as high as 20 cents per lb. These are the highest quotations for the metal for at least six years. In 1899, 19¼c was paid and prices were well sustained, when they broke to 13c. The prevalent view of the present movement is that it is natural and legitimate. *Bradstreet's* reports 226 business failures during the week ending Dec. 14 against 203 the week previous and 239 in the corresponding week in 1904.

VICTOR CHAIN GRATE STOKER.—The American Stoker Company, of Erie, Pa., has acquired from the McMyler Manufacturing Company, of Cleveland, Ohio, their chain grate stoker business, which has been operated under the trade name of the Victor chain grate stoker. The acquisition includes patterns, patents, drawings and good will. Mr. F. Girtanner, the designer of the stoker and the mechanical engineer under whom it has been developed, enters the employ of the American Stoker Company. The Victor stoker has been in successful operation for some time past in various parts of the country, notably in Indianapolis, Cleveland and Erie. One of its distinctive features is a rear attachment consisting of clinker breaker and dumping bars. The special merits of this attachment are that the fires can be forced and the capacity of the boiler increased without any extra wasting of fuel and positively without smoke. The commercial development of the Victor stoker has been somewhat retarded from the fact that the McMyler Manufacturing Company were so extremely busy with their own special line of ore handling machinery they could not give the stoker department the attention which it required; but the aggressive management of the American Stoker Company combined with the merits of the Victor stoker will undoubtedly soon make this machine an important factor in the field of automatic stoking. Hereafter it will be known as the American chain grate stoker. It will be handled by the American Stoker Company concurrently with its well-known "underfeed stoker." By the acquisition of this device the American Stoker Company is thus enabled to offer users of power stokers of any type desired.

THE HUDSON RIVER ELECTRIC POWER COMPANY, which is supplying power to the Utica & Mohawk Valley Railway Company for the operation of its electric car lines, between Little Falls, Frankfort, Utica and Oriskany, is installing on the boilers in its new steam turbine plant at Utica, what is known as the "Balanced Draft System," by means of which the blower and damper are automatically controlled and the heated gases are retained and consumed before they escape to the flue. A much cheaper class of fuel can be used and better results obtained on this system. The system has already been installed in several large plants throughout the country and the results obtained at the plant of the Hudson River Electric Power Company, at Utica, will be watched closely by all engineers interested in this class of work, as well as those interested in the subject of fuel economy and low cost of power production. The plant, when completed, will have a capacity of 10,000 horse power and will consist of the latest and most modern apparatus of its kind in the country. Steam turbines, of the Curtis type, are used with Deane condensers and in the boiler room Franklin, and Babcock & Wilcox water tube boilers are in use.

ELECTRIC RAILWAY BATTERIES.—A contract recently closed by the Electric Storage Battery Company with the Spokane & Inland Railway Company, Spokane, Wash., forcibly illustrates the flexibility of the storage battery and its adaptability to meet special conditions. In this instance the battery is installed to regulate the fluctuations of a single-phase railway load. Power is purchased as 3-phase, 60-cycle current from the Washington Water Power Company on the maximum demand basis, and delivered, through motor generator sets, to the single-phase line. Each motor generator set will be provided with a direct current machine mounted on the same shaft and connected to the terminals of the battery circuit. The battery charge and discharge will be effected by two boosters in the battery circuit operating in parallel with each other, each having a capacity equal to one-half the maximum output of the battery. These boosters will be controlled by the Electric Storage Battery Company's carbon regulator, which in this case will be made responsive to fluctuations of the alternating current supply, thus causing the battery to keep those fluctuations within narrow limits.

IMPORTATION OF LEAD.—Owing to the large demand for lead, and the scarcity of the American product, arrangements have been made for the importation of several thousand tons. The European lead, which is to be shipped from England, Belgium and Germany, will be delivered here at lower prices than the ruling rate for the domestic material, notwithstanding the duty and freight, amounting to 40 per cent of the initial cost. The ordinary quotation in Europe is about 2½ cents per pound, but, owing to the present demand, the price has risen about a cent. The import duty is 2⅛ cents and the freight about ⅛ cent. The present price for American lead, which is controlled by the American Smelting & Refining Company interests, is 6 to 6.10 cents per pound.

HARDY LAMP FAILURE.—Salem M. Hardy, of Pittsfield, Mass., manufacturer of electric lamps, has filed at Boston a petition in bankruptcy. His liabilities are scheduled at $37,517.11, and are all unsecured. There are no assets. There are nearly 100 holders of unsecured claims, some of the larger being the Gilmore Electric Company, of Boston, $6,631; Colorado Security Company, of Denver, Colo., notes, $9,000; E. H. Rollins & Sons, of Denver, Colo., notes, $3,000; F. P. Stevens, of Denver, Colo., notes, $3,000; Wyoming National Bank of Wyoming, $5,000, and Charles W. Beacon, of Cambridge, $2,500.

LARGE EXPORTS.—The report of the Department of Commerce and Labor on the exports of domestic products from the United States in November shows an increase of $11,202,165 over the exports of the corresponding month of 1904. The items which show the largest gains are breadstuffs, the exports of which increased $10,000,000, and provisions, which showed an increase of $3,300,000. The principal offset to these increases was the decrease in cotton exports, which were smaller by $1,900,000. The amount for the month were $99,340,072 and for the eleven months, $702,968,182.

ELECTRICITY IN SARNIA TUNNEL.—A Canadian correspondent writes that it is learned on good authority that the Grand Trunk Railway Company has let the contract for the equipment of the Port Huron-Sarnia tunnel with electric power for the operation of trains. The contract involves the building of large power houses in Port Huron and Sarnia. The total cost of the proposed improvements is said to be about $700,000. The third-rail system and electric locomotives will be used.

BALL & WOOD ENGINES have been installed by the Northern Westchester Lighting Company at Ossining on the Hudson. There are two tandem compound condensing of 425 hp each, driving generators of 250 kw capacity each. An Aultman Taylor boiler of 420 hp has also been added and a new switchboard. Mr. Stuart Wilder is the active vice-president and general manager.

WILKINSON STEAM TURBINE.—The International Power Company has obtained the exclusive manufacturing rights for the Wilkinson steam turbine, for both marine and stationary work, for the entire world. The 7,500-hp unit now building at the Providence works will be tested Feb. 1.

AN ECUADOR RAILROAD.—A special correspondent of the *Iron Age* notes that a new railroad is to be built in Ecuador under American engineers and with American material. Surveys have already been made and construction work is expected to begin inside of three months. The line will be called the Ferro Carril al Curaray. Charles H. Moore, first assistant engineer of the Erie Railroad, will be the chief engineer, and Walter G. Fox, formerly of the New York Central, is to be the first assistant engineer. They have made surveys of the road at the instance of the government which is to construct the system. The line will run from Ambato to San Antonio, a distance of about 125 miles. Ambato is the point where the trade from the interior of Ecuador concentrates. It is on the route of the Guayaquil & Quito Railroad, which system is now nearing completion to that place. It is located in the Andes at an altitude of some 8,500 feet above sea level. San Antonio is situated at the head of navigation of the Amazon River. It is about 2,700 feet above the Pacific Ocean. In the first instance wood fuel will be used on the road, but eventually electricity will be employed to operate the system, there being an abundance of water power along the route. One of the falls on the Pastaza River measures 198 feet in height and is estimated to have a capacity of upward of 250,000 hp, even in the dry season. There are three falls on tributaries of the Pastaza which are capable of developing 10,000 hp each

PHILIPPINE RAILWAYS.—Bids were opened last week for the concessionary grants for Philippine railroads. Speyer & Company, of New York, offered to construct about 425 miles of railway in the Island of Luzon without Government guarantee of bonds. It was explained that this offer was made in connection with the existing Manila Railway Company, Limited, which now has in operation over 200 miles of railway in Luzon (the Manila and Degupan line and branches). Morris McMicken, G. Gresskens, G. Poncin, Jacob Furth and E. C. Hughes, of Seattle, offered to build 100 miles of railway in southern Luzon, designated in circular as land No. 6, under 4 per cent guarantee for thirty years on 95 per cent of the cost of construction. They agreed to complete the road in three years instead of one. Keam, Van Cortlandt & Company, J. G. White & Company, Charles M. Swift (president of the Manila trolley system), with whom are associated Cornelius Vanderbilt, R. T. Wilson & Company, and the International Banking Corporation, offered to build 100 miles on the Island of Panay, 100 miles on the Island of Negros, and 95 miles on the Island of Cebu, under a 4 per cent guarantee for thirty years on 95 per cent of the cost of construction. Their bid stated that the construction would be done by J. G. White & Company.

ELECTRICITY IN THE CEMENT INDUSTRY.—Cement is divided into two classes, slag and natural cement. In the manufacture of natural cement the rock is taken from the quarry or mines and burnt in a kiln. It is then run through a conical crusher or between rolls and ground into a powder, after which it is conveyed to screens which separate the cement which is fine enough to be packed. The coarser particles then go to fine grinding machines, which are ordinary mill stones or emery-faced stones. Considerable power is required in these cement plants, for which electricity is coming into general use. Either the alternating or the direct current system is adopted, the choice depending on local conditions. The plant of the Iola Portland Cement Works at Dallas, Texas, is equipped with Westinghouse type S direct current motors, and a contract just closed with the Santa Cruz Portland Cement Company, San Francisco, Cal., gives a good idea of the size of some of these plants. This order calls for one 800-hp type C motor, ten 250-hp, fifteen 150-hp, one 75-hp and one 30-hp type CCL motors. These are all alternating current motors of the induction type and aggregate a total of 5,655 hp.

STANLEY ELECTRIC COMPANY.—President Chesney, of the Stanley Electric Manufacturing Company, said last week after a conference of its officers: "If nothing happens and present plans are followed we will build an iron foundry on the recently purchased Read land in Beaver Street. There is absolutely no truth in the statement of a morning paper that we are to build electric locomotives here." The foundry building, which will be built in the spring, will be 400 feet by 200 feet in size, and will be the second largest foundry in the State. The company, of course, expects and doubtless will receive decent treatment from the city in improvements in the matter of roads and fair treatment in the matter of taxes. The city recognizes that the growth of this company, the leading industry of the city, is a great factor in its growth. At the works business is rushing. Small contracts are pouring in, and last week a sizable contract for generators, switchboards, etc., was received from the California Gas & Electric Company, of San Francisco. The contract aggregates $65,000. The company is an old and large customer of the Stanley Company. The contract was secured by the San Francisco office.

COPPER AWAY UP.—Last week copper went to the highest price at which the metal has sold since May, 1899, when the Amalgamated Company's stock was floated. The metal sold then at 19¼ cents a pound; this week it touched 18¾ cents. Last year's high level was 15⅛, against 15⅛ in 1903, 13½ in 1902, 17 in 1901, 17 in 1900, and 19¼ in 1899. This month's extraordinary rise has led to much bewilderment, and no satisfactory explanation has been advanced. It cannot be accounted for by the export movement, because November shipments aggregated the lowest month's total of the year, being 9,099 tons below the November movement a year ago. When war broke out between Russia and Japan, in the first week of February, 1904, copper was selling at 12⅜ cents a pound. That was the year's low level. Within ten months it advanced nearly two cents, selling at 15⅛ cents in December, 1904. This year the market has ruled very firm, being influenced during the first six months by the unprecedented foreign shipments.

NATIONAL CARBON.—President James Parmelee of the National Carbon Company, is quoted as follows: "I have never seen such healthful conditions attending a period of great prosperity as at the present time. The copper market is a fair index of the situation with our company, and its activity is well known. From all the information we can gather, the conditions, which make it so are stable ones, and the year 1906 probably will be the best for business ever known. National Carbon earnings this fiscal year will be the best in its history, but just what they will be I am unprepared to say at this time. They will be sufficient, however, to assure dividends on the common and perhaps at a better rate than the shares have been paying."

ROBINS CONVEYING CONTRACTS.—The Robins Conveying Belt Company, New York City, has recently secured a large order for a series of conveyors for ore bedding purposes for the Garfield plant of the American Smelting & Refining Company. Among other orders now on hand is one from the Western Engineering & Construction Company, of San Francisco, for a 34-inch conveyor to be installed on a gold dredge in the Oroville district. This conveyor will be equipped with the Robins new style five-pulley troughing idlers. The Robins Company has also received an order from the Pittsburg Reduction Company for a belt conveyor intended for their East St. Louis works.

ELECTRICAL EXPORTS.—The statistics of exports for the month of October show a total for electrical machinery for the month of $527,669 as compared with $661,267 in October last year. For the ten months the total is $6,002,712 as compared with $5,342,064. Exports to Japan and Great Britain account for the bulk of this gain. The exports of electrical instruments, including telegraphs and telephones, was $454,224 as compared with $352,404, and for the ten months $4,416,154 as compared with $3,470,835 in 1904. The total for the ten months under the two heads is $10,418,860 in 1905 as compared with $8,812,899, a gain of well over a million.

ENGINE WANTED.—The Farmington Electric Light Co., of Farmington, Ill., Theodore Bass, manager, will be in the market in the early spring for a 125 hp high speed engine.

Financial Intelligence.

THE WEEK IN WALL STREET.—Stock prices receded at the end of the week after the renewed advances and bullish manipulation during the earlier part. New high-record quotations were made in a number of leading railroads and industrials, the features of the market including the United States Steel stocks and Amalgamated Copper. Other copper stocks, both at Boston and New York, also displayed great strength on the further rise in the prices of the metal. The fact that the decision of the New York Court of Appeals denying the application for a reopening of the ballot boxes in New York City served as occasion for a sharp spurt in Metropolitan Street Railway, Metropolitan Securities, Brooklyn Rapid Transit and Interborough Stock on the "curb." Of the electric stocks, Allis-Chalmers, both issues, were the only ones to show inactivity and weakness. Common lost 1⅝ and preferred 3¼ points net, the closing prices being 21⅝ and 62, respectively. General Electric was strong on limited trading and in closing at 176½, ex-div., made a net gain of 3⅛ points. Westinghouse closed at 175, which is a net gain of 2 points. American Locomotive common closed at 68½, a net decline of 1¼ points, and preferred at 116½, a loss of ½ point. There was active trading in Brooklyn Rapid Transit which advanced to the highest figure of the year—91⅝—and closed at 90¼, this being a net gain of 4¾ points. The sales of this stock aggregated 382,200 shares. Metropolitan Street Railway closed at 120, with a net gain of 1½ points, and Interborough Rapid Transit made a gain of 8 points on the "curb" market, closing at 219, after having touched 224. Western Union Telegraph closed at 92⅝, a fractional advance, and Mackay Companies 51⅛, ex-div.,

a gain of 1⅜. On the curb market the feature was the trading in the copper stocks. This was on an enormous scale, ten stocks alone making a total of about 1,000,000 shares. The general list offered few features. Interborough Rapid Transit advanced sharply at the close of the week in connection with a dubious report that this company had secured control of the Metropolitan Securities Company. Following are the closing quotations of Dec. 19:

NEW YORK

	Dec. 12	Dec. 19		Dec. 12	Dec. 19
Allis-Chalmers Co	22	21⅛	General Electric	183	174
Allis-Chalmers Co. pfd	62	61	Hudson River Tel.	..	...
American Dist. Tel.	37	37	Interborough Rap. Tran.	208	217⅛
American Locomotive	70	68	Mackay Cos.	50⅜	54⅜
American Locomotive pfd.	116⅛	116	Mackay Cos. pfd.	72	72
American Tel. & Cable	89	87	Marconi Tel.	...	...
American Tel. & Tel.	133	134	Metropolitan St. Ry.	118⅜	120⅞
Brooklyn Rapid Transit	86	88	N. Y. & N. J. Tel.	...	...
Electric Boat	25	28	Western Union Tel.	93	93¾
Electric Boat pfd.	65	70	Westinghouse com.	171	173
Electric Vehicle	12	12	Westinghouse pfd.	..	...
Electric Vehicle pfd.	17	15			

BOSTON

	Dec. 12	Dec. 19		Dec. 12	Dec. 19
American Tel. & Tel.	135	138¼	Mass. Elec. Ry. pfd.	60	58
Cumberland Telephone	...	...	Mexican Telephone	1⅛	...
Edison Elec. Illum.	239	...	New England Telephone	132	131⅛
General Electric	...	...	Western Tel. & Tel.	..	...
Mass. Elec. Ry.	...	...	Western Tel. & Tel. pfd.	..	...

PHILADELPHIA

	Dec. 12	Dec. 19		Dec. 12	Dec. 19
American Railways	52¼	52	Phila. Electric	8⅝	8⅝
Elec. Co. of America	11⅛	11	Phila. Rapid Trans.	32⅛	30⅛
Elec. Storage Battery	82	81¼	Phila. Traction	100¾	100⅛
Elec. Storage Battery pfd.	..	...			

CHICAGO

	Dec. 12	Dec. 19		Dec. 12	Dec. 19
Chicago City Ry.	200	197¼	National Carbon	75	76
Chicago Edison	...	...	National Carbon pfd.	117	*120
Chicago Subway	...	...	Union Traction	..	...
Chicago Tel. Co	...	...	Union Traction pfd.	..	...
Metropolitan Elev. com.	26⅛	26⅛			

* Asked.

DIVIDENDS.—The Ridge Avenue Passenger Railway Company has declared a regular quarterly dividend of $3 a share, payable January 2. Directors of the Railway Equipment Corporation have declared the regular monthly dividend of 1½ per cent. Westinghouse Air Brake Company's directors have declared the regular dividend of 2½ per cent quarterly and 2½ per cent extra, payable January 2. The directors of the Consolidated Traction Company of New Jersey have declared the regular semi-annual dividend of 1¾ per cent, payable January 15. The regular Western Union Telegraph quarterly dividend of 1¼ per cent is payable January 15 to stockholders of record December 20. Books close December 20 and reopen January 2. The Boston, Revere Beach & Lynn R. R. has declared a dividend of $2 per share, payable January 1, 1906. This is an increase of $1 over the last semi-annual dividend. The directors of the Westinghouse Machine Company have declared the regular quarterly dividend of 2½ per cent, payable January 10. The Cumberland Telephone & Telegraph Company has declared a regular quarterly dividend of 1¾ per cent, payable January 1, 1906. This dividend makes the eighty-ninth declared by the company. The directors of the Twin City Rapid Transit Company have declared a quarterly dividend of 1¾ per cent on the preferred stock, payable Jan. 2. The directors of the United Traction & Electric Company of New Jersey have declared a dividend of 1¼ per cent on the capital stock, payable Jan. 2.

WESTERN UNION EARNINGS.—The Western Union Telegraph Company's statement for the December 31 quarter (partly estimated) compares with the actual figures of the corresponding quarters of 1904, 1903 and 1902, as folows:

	1905. (Estimated.)	1904. (Actual.)	1903. (Actual.)	1902. (Actual.)
Net revenue	$1,900,000	$1,872,966	$2,000,060	$2,117,330
Bond interest	331,300	297,550	286,300	252,550
Balance	$1,568,700	$1,575,416	$1,713,760	$1,864,780
Dividends	1,217,021	1,217,021	1,217,017	1,217,011
Surplus	$351,679	$358,395	$496,743	$647,769
Previous surplus	16,433,481	15,434,863	13,863,603	11,528,617
Total surplus	$16,785,160	$15,793,258	$14,360,346	$12,176,386

The actual returns for the September 30 (1905) quarter follow: Net revenue, $2,007,593; bond interest, $331,300; balance, $1,676,293; dividends, $1,217,021; surplus, $459,272; previous surplus, $15,974,209; total surplus, $16,433,481.

NEW YORK CENTRAL DEALS.—New York Central interests, which comprise the Vanderbilt-Andrews traction syndicate, have purchased control of the Rochester Railway & Light Company, thus practically completing a chain of trolley lines across the State from Albany to Buffalo. The New York Central interests began several years ago the policy of absorbing the electric traction systems paralleling their lines across the State. The Vanderbilt-Andrews syndicate made its first entrance into Rochester last spring, when it acquired the Rochester & East Rapids Railway, running southeast as far as Geneva, a distance of forty-eight miles. The system of the Rochester Railway & Light Company covers 105 miles of track in Monroe and Wayne counties. The concern has $14,926,000 capital outstanding, of which $5,526,000 is bonded indebtedness and $3,000,000 preferred and $6,500,000 common stock. The syndicate buys control of the company by purchase of the common stock at 125. The deal was concluded Saturday, but it will be a matter of weeks before the new ownership gets control of the system.

INDUSTRIALS IN LOANS.—Reports have been circulated that large lending institutions were cutting down industrials in loans where they represented more than 25 per cent of the collateral offered. This action was taken, it was said, as a precaution to offset the extraordinary advance in the price of some shares. As a rule, however, the banks have not pursued any such course, the restrictions applying only to certain few banks and in exceptional cases. Most of the banks continue to accept 35 per cent of active industrial shares as collateral for loans, and, where the borrowers were of the highest standing, even a larger proportion was allowed. One of the largest banks allowed borrowers to give industrial shares for half the collateral required, and an official of another bank admitted that they had taken 75 per cent industrials as security for "over-night loans."

INCREASE OF CAPITAL.—The Detroit, Ypsilanti, Ann Arbor & Jackson Railway at a meeting of its stockholders held in Detroit, Dec. 4, authorized the issue of $600,000 additional 5 per cent bonds, the proceeds to be used in the building of a spur from its main line to Dexter, and in the purchase of additional equipment made necessary by its rapidly increasing business. Including this latest issue, the bonded indebtedness of the company will be $3,200,000 upon 104 miles of road, doing a very prosperous and rapidly increasing business, both in its passenger and freight departments, the last year, according to the reports of the treasurer, being the most prosperous in the history of the company.

MOHAWK VALLEY STOCK.—The Mohawk Valley Company, of Utica, N. Y., which was incorporated last February, has filed with the Secretary of State a certificate of increase of capital stock from $100,000 to $10,000,000. The certificate is signed for the stock control by Horace E. Andrews. Edward L. Rossiter, as treasurer of the company, certifies that Mr. Andrews is the owner of all the capital stock of the company. This increase is supposed to have direct reference to the proposed electrification of the West Shore Railroad in the Mohawk Valley, in connection with the recent absorption of the Mohawk Valley trolley lines by New York Central interests.

PHILADELPHIA BELL TELEPHONE.—The Bell Telephone Company of Philadelphia will earn around $1,250,000 net for the fiscal year ending Dec. 31, 1905. The large amount of new capital invested in recent years is now yielding returns. The net earnings this year will be nearly 8 per cent on $16,000,000 stock, as compared with less than 7 per cent on $14,000,000 stock last year. The company has invested the proceeds of $10,000,000 more share capital than it had five years ago, the present amount being 2⅔ times what it was then. The net earnings have been more than doubled.

SOUTHERN BELL TELEPHONE.—At the special meeting of the Southern Bell Telephone Company an increase of the capital stock from $1,000,000 to $30,000,000 was authorized. The majority of the outstanding stock is owned by the American Telephone & Telegraph Company.

CUMBERLAND TELEPHONE.—The Cumberland Telephone & Telegraph Company's increase in capital of 25 per cent is to provide for next year's new business. Rights accue Jan. 10, 1906. The stock will be issued Feb. 1, payable then or beginning then and quarterly thereafter.

B. R. T. BONDS.—The Brooklyn Rapid Transit Company has applied to the New York Stock Exchange to list $3,042,000 additional first refunding convertible mortgage 4 per cent bonds of 2002. This brings the total of that issue up to $20,042,000.

DEAL IN OHIO.—It is stated from Cincinnati that plans have been completed enabling the Widener-Elkins interests to secure control of the Zanesville Railway, Light & Power Company and the Mansfield Railway, Light & Power Company.

MILWAUKEE BONDS.—Spencer Trask & Company and N. W. Harris & Co. are offering $2,000,000 Milwaukee Electric Railway & Light Company refunding and extension mortgage 4½ per cent bonds, due Jan. 1, 1931.

DETROIT TROLLEY BONDS.—The Detroit United Railway Company has applied to the New York Stock Exchange to list $525,000 additional first consolidated mortgage 4½ per cent bonds of 1932.

BEAVER BONDS.—The Beaver Traction Company recently acquired by the Philadelphia Company will issue $175,000 5 per cent bonds.

General News of the Week

The Telephone.

DECATUR, ALA.—The Intercounty Telephone Company, which is an independent concern, is completing its system in this section. The capital stock of the company is $20,000.

OAKLAND, CAL.—The Home Telephone Company, of Alameda County, has secured a franchise in this city, bidding therefor $35,431.30.

LOS ANGELES, CAL.—The Adams-Phillips Company has begun the erection of a large power plant to generate electric power for the town of Ventura. The plant will utilize the water from the Matilija.

SAN FRANCISCO, CAL.—The Home Telephone Company's petition for an immediate hearing on the question of its application for a franchise in this city has been denied by the joint finance and public utilities committee of the Board of Supervisors. This will throw the responsibility of such action on the incoming Board next year.

LOS ANGELES, CAL.—The waters of Kern River will be completely utilized by August 1, 1906, if the plans of the Edison Electric Company, of this city, and the Risdon Iron & Locomotive Works, of San Francisco, are carried out. To the latter concern the Edison Company has let the contract for the steel lining of the pressure tunnel. It will require 800 tons of steel to supply the 1,800-ft. tunnel, which will be 7 ft. 6 in. in diameter. The drop is 900 ft., which, it is believed, will develop 25,000 horse-power.

DANBURY, CONN.—The Southern New England Telephone Company has purchased land in this city on which to erect a new exchange building. The new exchange will be equipped with the common battery system. L. W. Robinson, of this city, is the architect.

DOVER, DEL.—The Central Home Telephone Company, of Wauseon, Ohio, has been incorporated here with a capital stock of $5,000,000. The incorporators are Edwin L. Barber, Wauseon; Joshua D. Powers, Louisville, Ky.; John C. Montelrith, Bloomington, Ind.; James E. Bergin, Nanticoke, Pa.

WASHINGTON, D. C.—As a result of negotiations between the district electrical engineer, Mr. Walter C. Allen, and Mr. F. H. Bethell, general manager of the Chesapeake & Potomac Telephone Company, the District Commissioners have received a proposal from the telephone company to change the present magneto system to the common battery system.

WEISER, IDAHO.—A franchise has been granted by the Council to the Independent Long Distance Telephone Company to establish a system in this city.

QUINCY, ILL.—The Quincy Long Distance Telephone Company has been incorporated with a capital stock of $2,000 by F. J. Pennick, J. R. Pearce, and S. Scott.

FORRESTON, ILL.—The Forreston Mutual Telephone Company has been incorporated with a capital stock of $5,000 by Henry Zumhall, Henry Radner and Joseph Duetzman.

GALESBURG, ILL.—The Galesburg Union Telephone Company has petitioned the City Council for a perpetual franchise, similar to the one held by the Bell Company. The former company recently increased its capital stock from $150,000 to $250,000. It promises to make some improvements for the betterment of the service.

CHICAGO, ILL.—The Chicago Telephone Company's new directory shows that a new office, Humboldt, has been opened on the northwest side of the city on Western Avenue, near North Avenue, being made necessary by the rapid growth of telephones in that part of the city. About 2,800 West, Ashland, Ogden and Seeley subscribers have been transferred to the new exchange and are being operated under the name Humboldt. On the south side the office names South, Brown and Green have been abolished and the single name Calumet is used. This change has been made to reduce the number of office names and principally in connection with doing away with the word South.

CONVERSE, IND.—The petition of O. L. Barger of this place for a franchise in Marion to install and operate an automatic telephone system has been passed upon by the Board of Public Works and recommended to the City Council. The rates for residence are not to exceed $1.50 per month and for business houses $2.50 per month. No charge shall be made until 1,000 telephones have been installed. Thirty telephones are to be provided for city offices free of charge. A tax of 66⅔ cents per telephone is to be paid to the city annually.

MUSCATINE, IA.—The Mississippi Valley Telephone Company will place all its wires in this city underground.

MAXBURG, IA.—The Madison County Mutual Telephone Company has been incorporated with a capital stock of $2,500.

REINBECK, IA.—The United Exchange Company has been incorporated to do a telephone business, the capital stock being $35,000.

RUSTON, LA.—The City Council has passed an ordinance granting permission for the use of the streets of the city for the construction of a new telephone service.

PORTLAND, ME.—A bill in equity has been filed before the Supreme Court by the local minority stockholders of the Northeastern Telephone Company, to prevent carrying out the resolution passed at a special meeting of the stockholders to convert $400,000 of common stock into 5 per cent accumulative preferred stock, and the issue of $350,000 of new stock in exchange for $250,000 of outstanding mortgage bonds. The Northeastern Company was organized in this city several years ago, purchased the charter of the Dirigo Telephone Company and has established an automatic system here.

SOUTH HADLEY, MASS.—The New England Telephone Company has made arrangements to establish an exchange in this city.

EVELETH, MINN.—The Mesaba Telephone Company contemplates erecting a new exchange building in this place.

COOKSTON, MINN.—The Northwestern Telephone Exchange Company will erect a new building here at a cost of $20,000 and will install a central energy system.

MT. ZION, MO.—The Mount Zion Mutual Telephone Company has been granted articles of incorporation. The incorporators are J. D. Snyder, J. W. Stanton, T. H. Good, J. N. Butler, E. P. Edwards, T. J. Bilderlack and others. The capital stock is $4,800.

LINCOLN, NEB.—The Johnson County Home Telephone Company, with an authorized capital stock of $50,000, has filed articles of incorporation. Incorporators are J. H. Luneman, W. D. Waganer and others.

ALBANY, N. Y.—The Independent Union Telephone Company of this city has secured possession of the Independent Telephone Company of Herkimer County, which operates a rural line out of the village of Herkimer.

HAMMONDSPORT, N. Y.—The Niver telephone lines have been purchased by the subscribers for $700, and a company has been organized to conduct the business. The capitalization is $5,000, and the officers are: President, J. W. Brundage; vice-president, William Dildine; secretary, Pierce Brundage; treasurer, James H. Smellie.

LINTON, N. D.—The Dakota Central Telephone Company of Aberdeen proposes to establish a local exchange here.

LOWELL, OHIO.—The L. H. W. Telephone Company has been formed in this place by W. D. Davis, C. F. Shinn, John Mattern and others, the capital stock being $10,000.

MARYSVILLE, OHIO.—Mr. J. L. Sayre, of Richwood, is organizing a $10,000 telephone company to build a system in Ostrander to cover the rural districts between Marysville and Delaware.

DOYLESTOWN, OHIO.—The Marshallville & Rittman Telephone Company and the Millersburg & Orrville Telephone Company will be consolidated in the near future, negotiations with that end in view having been practically completed.

SALEM, ORE.—The Automatic Telephone Company has been granted a franchise by the Council of this City. The Pacific States Telephone Company has filed a suit against the city to vacate the franchise.

OLNEYVILLE, R. I.—The Providence Telephone Company has made plans to erect a new telephone exchange in this place.

SPRINGFIELD, TENN.—Officers have been elected by the directors of the Springfield Home Telephone Company, as follows: President, Thos. Pitt; vice-president, John McMurry; secretary, A. L. Dorsey; treasurer, H. T. Stratton, Jr.

MONTGOMERY, TEX.—The Montgomery Telephone Company has been incorporated with a capital of $10,000. The incorporators are: F. W. Peynghaus, M. S. Peynghaus and Robert J. Sullivan.

BRENHAM, TEX.—The Brenham & Washington Telephone Company has been incorporated with a capital stock of $1,500. The incorporators are John M. Mathis, E. P. Curry and D. C. Giddings.

TACOMA, WASH.—Edward E. Webster, of Seattle, has been granted a franchise to install an automatic telephone exchange here.

WALLA WALLA, WASH.—The Council has granted a franchise to the Automatic Telephone Company for a term of 25 years.

BELLINGHAM, WASH.—The Home Telegraph & Telephone Company has been granted a franchise to operate a system in this city.

SPOKANE, WASH.—The Seward Co-operative Telephone Company, which was incorporated in this city last year, contemplates extending its lines in several directions from Nome.

OLYMPIA, WASH.—Charles E. Sumner, of Portland, has been granted a franchise by the City Council to operate an automatic telephone system in this city. The stipulated rates are $3.25 per month for business telephones and $1.75 for residences.

MONROE, WIS.—The assets and plant of the Independent Consolidated Telephone Company have been sold at public auction by Receiver John E. Riley.

MADISON, WIS.—The Wisconsin Telephone Company and the Door County Telephone Company have entered into an agreement by which the latter company will connect with the central office in this city of the Wisconsin Company, and there will be an interchange of business between the two concerns.

VANCOUVER, B. C.—The British Columbia Electric Company will erect a telephone service in North Vancouver during the winter.

BRANTFORD, ONT.—Three telephone companies are struggling for a franchise in the city of Brantford. The Bell Company desires to hold what it has, which is an exclusive franchise, while the Canadian Machine Company and the Ontario Telephone Company are looking for competitive franchises. The Canadian company desires a 21 years' agreement, with an option for municipal ownership and prices to be $25 for business and $15 for residence telephones. The Ontario company wants a 20-year franchise at $25 for business and $18 for residence, with certain reductions for party lines.

MONTREAL, QUE.—The recorder of the city of Montreal has rendered a judgment by which the Bell Telephone Company will hereafter be compelled to pay the civic tax of $5 on each of the company's slot telephone machines.

Electric Light and Power.

ENTERPRISE, ALA.—The Enterprise Power & Light Company, of Enterprise, has been incorporated with a capital of $20,000 by J. P. Rouels, O. C. Doster, Jr., and others.

POCAHONTAS, ARK.—S. C. Dowell, of Walnut Ridge, is interested in the construction of an electric light plant at this place.

POMONA, CAL.—The Ontario Power Company is considering the installation of about 750 horse-power of steam and electric machinery. Plans are in the hands of J. E. Adamson, mechanical engineer of Pomona. The company new operates a 1200-hp hydro-electric plant in San Antonio canyon.

LOS ANGELES, CAL.—That H. E. Huntington intends to construct on Warner's ranch, about 20 miles from Oceanside, a power plant has been shown by the filing in the county recorder's office at San Diego of a notice of appropriation on 50,000 inches of the waters of San Luis Rey River. The significant feature of the filing is the fact that the notice is in the name of Charles Forman, secretary of the Pacific Power & Lighting Company, which furnishes the power for the street railway lines in Los Angeles. Mr. Huntington is a heavy stockholder in the power company, and there is now little doubt that it is he who is back of the proposition to build a power plant near the San Luis Rey River. It is expected that the articles of incorporation for the new company will be filed within the course of the next three weeks, and that work of construction on the plant will begin inside of the next 30 days.

BOULDER, COL.—Harry D. McCutcheon, of Pittsburg, Pa., is interested in the development of the water power here, and has asked the City Council for a franchise.

WALLINGFORD, CONN.—The municipal electric light plant shows a business of $16,967 for the year ending in August and 415 consumers on the circuits, 214 on meters and 201 at flat rates.

RICHLAND, GA.—An election will soon be held to vote on issuing $15,000 electric light bonds.

AUGUSTA, GA.—A movement is on foot here looking to the construction of a municipal lighting plant.

ATLANTA, GA.—The Southern Light & Power Company has presented a petition to the Council for an electric light franchise. The recommendation of the council committee limits the charges to $50 per annum for each arc light, and $22 per annum for incandescents. The charge for power is to be not more than 8 cents per kw-hour.

MOLINE, ILL.—A. A. Woodworth, of East Moline, has asked the village board of East Moline for an electric light franchise. It is stated that Chicago capital is interested.

MONMOUTH, ILL.—Wm. and S. Mainland, of Oshkosh, Wis., and W. J. Ferris, of Chicago, Ill., are interested in the construction of an electric light plant here, to be conducted under the title of Monmouth Gas & Electric Company. O. G. F. Markhus, of Oshkosh, is the engineer.

RICHMOND, IND.—The municipal electric light plant, it is stated, earned during the month of November $2,108.81 in excess of the operating expenses.

MICHIGAN CITY, IND.—The Michigan City Light & Power Company has been incorporated, with a capital of $150,000, by Robt. F. Garrettson, and others.

CEDAR RAPIDS, IA.—The City Council has passed a resolution directing the mayor and recorder to enter into a contract with the Cedar Rapids and Iowa City Railway & Light Company for the lighting of the streets of this city after Nov. 1 this year at $55 per light per year, according to the Philadelphia moonlight schedule.

BELLEVILLE, KAN.—The question of establishing an electric light plant in connection with the water works is under consideration here.

QUINCY, MASS.—The report of a special committee in favor of a municipal lighting plant has been tabled by the City Council.

CROSWELL, MICH.—The citizens have voted to issue $5,000 bonds for water works and a lighting system.

CRYSTAL FALLS, MICH.—A preliminary injunction has been served on the members of the Village Council of Iron River, restraining them from issuing the $30,000 of bonds, recently voted at a special election, for the purpose of rebuilding the water works station and installing an electric light plant.

BAY CITY, MICH.—The Bay City Traction & Electric Company takes the position that under the charter Bay City, as a municipality, has no authority to do commercial lighting on the east side of the river. The traction company proposes to test the matter in the courts. It has been decided that a friendly suit be instituted to decide whether the city must stop furnishing its electric lights for commercial purposes on the east side. The company once made the city an offer of $60 per lamp per year. It is alleged that the actual cost per lamp per year under the city system is over $80.

AIKEN, MINN.—The Council will purchase a 95 to 125-kw. dynamo for the city lighting plant.

FARMINGTON, MINN.—The question of constructing an electric light plant and water works here, at a cost of $14,000, is under consideration.

CROOKSTON, MINN.—A committee has been appointed to look into the advisability of constructing an electric plant to light the court house and jail. N. A. Haffard is the county auditor.

HARLEM, MONT.—This town has in contemplation the construction of an electric light plant.

JOPLIN, MO.—The Consolidated Light, Power & Ice Company has been incorporated with a capital of $1,000,000, by Geo. Moore, A. M. Barrow, David Hoag and others.

MARCELINE, MO.—The Marceline Electric Light Company, of Marceline, has been incorporated, with a capital of $20,000, by Geo. W. Early, Wm. P. Callahan, and others.

MIDDLETOWN, N. Y.—The State Electric Light & Gas Commission has granted permission to the Consumers' Light & Power Company, of Middletown, to transfer its plant and franchise to the Orange County Lighting Company, free of incumbrance, for a consideration not exceeding $43,000, with the condition that the price to consumers shall not be changed during the next five years.

ALBANY, N. Y.—The State Gas Commission has received an application from the Genesee County Electric Light, Power & Gas Company for consent to increase its capital stock from $100,000 to $250,000, and for permission to issue $100,000 of preferred stock, $100,000 common stock and $100,000 first mortgage bonds of an authorized issue. The application will be heard in Albany on Dec. 29. The commission has denied the application of the Clyde Gas & Electric Company for a certificate of approval of incorporation and consent to issue $25,000 of capital stock. The Clyde Gas & Electric Company was formed to take over the gas and electric plant of a company by the same name which has not been operated for three or four years. The application was opposed by the Wayne County Electric Company, of Lyons, which company furnishes power to Clyde. The commission has granted the application of the Palmyra Gas & Electric Company for consent to issue bonds to the amount of $40,000.

GOLDSBORO, N. C.—The Board of Aldermen has refused all offers for the purchase of the electric light plant and has decided to secure the services of an expert to determine what is needed to put the plant in first-class condition. There were several offers to buy the plant outright and some offers to lease it. It is probable that the city will furnish the necessary apparatus and continue to operate the plant.

SANTA FE, N. M.—The Rio Grande Land, Water & Power Company has been incorporated with a capital stock of $1,000,000. The incorporators are A. W. Hoffman, E. W. Shutt and W. B. Childers.

EL RENO, OKLA.—The El Reno Gas & Electric Company has been incorporated, with a capital of $150,000, by Geo. J. Hickox and F. D. Howell, of El Reno, and others.

PORTLAND, ORE.—The Mt. Hood Electric Company, which has established a power plant on the Sandy River, has decided to ask the City Council for a franchise. The company was formed a year ago with a capital stock of $1,000,000. S. B. Cobb is president; J. E. Davis, vice-president; Samuel Connell, secretary, and C. W. Nottingham, treasurer.

EDGEFIELD, S. C.—A committee has been appointed with J. C. Sheppard as chairman to consider the question of constructing water works and an electric light plant. C. E. May is the mayor.

CHATTANOOGA, TENN.—The Chattanooga & Tennessee River Power Company will issue bonds to the amount of $3,500,000. To secure these bonds a first mortgage on all the property of the company has been registered. The bonds are to run for 50 years.

PROVO, UTAH.—Frank C. Kelsey, of Salt Lake City, willl be engineer for the proposed water works and electric light plant for which the city recently sold $91,000 bonds.

LURAY, VA.—The Shenandoah River Power & Light Company has been organized at this place. The officers are: President, T. J. Borey; vice-president, Charles S. Landram, both of Luray. The company is building a dam across the Shenandoah River, two miles west of this place.

PORT TOWNSEND, WASH.—The City Council has granted John Siebenbaum a franchise for an electric light plant.

RITZVILLE, WASH.—The Ritzville Electric Company has purchased the lighting plant here and will erect a new central station, arrangements for which have already been made. Mr. H. Warner is secretary of the company.

EVERETT, WASH.—The City Council has granted to Clay Allen, of Seattle, representing the Snoqualmie Light & Power Company, a three-year franchise; also a contract for lighting the city for the same period, at $6.50 per light per month. The system will be installed at once and be completed by Mar. 1, 1906.

NORTH YAKIMA, WASH.—The Northwest Light & Water Company will commence its power plant about April 1. Foundations will be laid this winter. Water wheel, steam and electric equipment for 5,000 horse-power will be installed. There will be ten miles of transmission line to this city.

OLYMPIA, WASH.—J. A. Kerr, of Seattle, has filed articles of incorporation for the Hanford Irrigation and Power Company, which proposes to reclaim 25,000 acres of land by irrigation near Priest Rapids. The principal backers of the company are: C. J. Smith, J. H. McGraw, Judge C. H. Hanford, H. K. Owens and Manly B. Haynes. Priest Rapids is in Yakima County, where the Columbia River cuts through the sage-brush plains of Central Washington. The project will involve an expenditure of $500,000.

BARRE, VT.—The Consolidated Lighting Company has asked for bids for the construction of a substation in this city.

PRINCE ALBERT, CAN.—Willis Chipman, of Toronto, has prepared plans to develop the water power situated 12 miles from here and to convey it to the town for light, heat and power purposes. Address Mayor Cowan.

SYDNEY, N. S.—The Dominion Coal Company has decided to operate its plant from the central electrical station, to be located at Dominion No. 2. The longest distance over which power will be transmitted will be to Dominion No. 6, eight miles from the proposed station.

EUGENIA, ONT.—The Georgian Bay Power Company, of Toronto, Ont., will construct a power plant at Eugenia, to cost about $250,000. Bids will be called for about April 1. H. von Schon, of Detroit, Mich., is the engineer.

OTTAWA, ONT.—Mayor Ellis, of the city of Ottawa, has prepared a detailed statement of the working of the civic electric plant since it was taken over on July 2, last. On its business since then, a gross profit of $3,253 was made, which leaves a deficit of $1,200 when the interest and sinking fund on the $200,000 invested is provided for. As the most profitable portions of the year are yet to come, the mayor thinks that, at the end of the first year's operation, a net profit will be shown.

The Electric Railway.

LOS ANGELES, CAL.—The City Council of San Diego has sold a street railway franchise in the eastern part of the city to Lloyd S. Ackerman, of San Francisco, for $6,000. Two other franchises for street railways have been sold in San Diego recently—one to E. B. Webster and another to H. A. Howard, both of San Diego. The franchise of the San Diego & Eastern Railroad Company has been extended for one year.

NORWICH, CONN.—It is reported that the Consolidated Railway Company is considering a proposition to centralize the electrical generating plants for the four divisions in southwestern Connecticut, comprising the Norwich and Willimantic, the Norwich Street Railway, the Montville Street Railway and the New London Street Railway systems, by doing away with the four separate power stations and substituting for them a central generating station at Thamesville, in this city.

BELLEVILLE, ILL.—The McKinley syndicate is attempting to get a right of way for an electric railway through Belleville. A petition is being circulated among property owners. If enough signers are secured the petition will be presented to the city council. The representative states that the company intends constructing an electric railway from East St. Louis to Cairo. If the franchise is granted, the company, it is said, will pay the city a yearly compensation for the franchise.

EVANSVILLE, IND.—Articles of incorporation have been filed for the Louisville Northern Railway & Lighting Company. The capital stock of the company is $5,000,000.

INDIANAPOLIS, IND.—The Indianapolis, Newcastle & Toledo Electric Railway Company has filed a mortgage with the recorders of Marion, Hancock, Henry, Wayne, Madison, Delaware, Randolph and Jay counties to secure a bond issue of $4,500,000. The company expects to build a line from here to Newcastle and Winchester, from Newcastle to Richmond, from Newcastle to Muncie and from Shirley to Anderson. It is also making plans for a line from Indianapolis to Toledo, and for a belt line around this city. D. M. Parry, of Indianapolis, is president, and C. S. Hernly, of Newcastle, secretary.

OSKALOOSA, IA.—The Oskaloosa & Buxton Electric Railway Company is securing right of way for its proposed line between Oskaloosa, Beason, White City and Buxton, work on which will be begun early next spring. The line will be 18 miles long. Power will be rented from the Oskaloosa Traction & Light Company. The officers of the company are: President and general manager, Harry E. O'Neill; vice-president, W. R. Lacey; secretary, C. E. Lofland; treasurer, George Kolback, all of Oskaloosa.

WINFIELD, KAN.—At a meeting of the Commercial Club a resolution was passed asking the city council to call an election to vote $20,000 in bonds for the interurban railway to connect Winfield, Arkansas City and Chilocco.

AUGUSTA, ME.—Articles of association have been filed by the Portland & Brunswick Extension Railway for a line to be operated by electricity or compressed air in the towns of Yarmouth, Cumberland and Falmouth and the city of Portland, a total length of 12 miles. The capitalization is placed at $48,000. The directors are E. J. Lawrence, A. B. Page, S. A. Nye and Amos F. Gerald of Fairfield, and Cyrus W. Davis, of Waterville.

BOSTON, MASS.—The Railroad Commissioners have authorized the Old Colony Street Railway to issue $200,000 additional capital stock, at par, of which $141,000 is to complete the payment for the alternating current system and the remaining $59,000 for improvements.

WARE, MASS.—Authority has been granted by the Railroad Commission to the Ware & Brookfield Street Railway Company to issue capital stock to the amount of $100,000 for the purpose of securing control of the street railway bought from the receiver of the Hampshire & Worcester Street Railway Company.

BOSTON, MASS.—The Boston Transit Commission has just issued its annual report for the fiscal year ending June 30. It says that the trains now run through the subway will pass through the Washington Street tunnel as soon as it is completed, and the subway will be restored to its original use as a route for cars from the surface system. Work on the tunnel has been carried on in five sections without interference with the convenience of the public. The Commission states that the Boston Elevated Railway Company, which leases the present subway, has paid to the city of Boston $3,950.81 as excess rental on account of having run a greater number of trips than would amount to the rental, charged at 5 cents a single trip. The payments on this account previously amounted to $10,169.40, making a total of $14,120.21. Chief Engineer Howard A. Carson says that 50 per cent. of the tunnel will be straight and 40 per cent. will be built level. The report says the income of the city from the East Boston tunnel should amount to about $80,000 per year.

MUSKEGON, MICH.—Eastern capitalists have an option on the property of the Muskegon Traction & Lighting Company and it is said its sale is about to be consummated. It is said that the option gives the parties buying the right to purchase the bonds of the company at par and accrued dividend and the common stock at $75 a share. The company is now bonded for $600,000 and has an issue of $600,000 common stock. It means cash valuation of $1,110,000 for the entire properties of the company, which comprise the street railway, electric lighting and gas plants. It is said that under the new owners provisions will at once be made for an extension of the street railway lines and the gas and electric lighting systems.

SYRACUSE, N. Y.—The stockholders of the Syracuse & South Bay Railway Company have approved the plans to increase the capital stock from $120,000 to $1,000,000, to be divided into $100,000 preferred and $900,000 common.

NEW YORK, N. Y.—At the annual meeting of the Metropolitan Securities Company the following directors were elected to hold office until December, 1908: Charles A. Conant, Thomas P. Fowler, Frank S. Gannon, Richard W. Meade and Edward W. Sayre.

NEW YORK, N. Y.—It is stated that the Belmont interests, which own the New York & Queens County Railway, have acquired control of the Long Island Electric Railway Company, of Jamaica, N. Y. This line is about 27 miles in length and is successor to the New York & North Shore Railway and connects Brooklyn, Queens, Jamaica and Far Rockaway. The president of the company is Charles A. Porter, of Philadelphia.

CLEVELAND, OHIO.—The South Lorain & Eastern Traction Company has been incorporated by A. B. Stuber, A. A. Lederer, D. T. Miller, R. C. Linden, Sigmund Lederer and others of Cleveland. The company proposes to build a line from Cleveland to South Lorain.

SALEM, ORE.—The City Council has granted a franchise to the Willamette Valley Electric Railway Company to operate a system in this city.

YORK, PA.—The Lewisberry & Shrinestown Electric Railroad Company has been organized to build a trolley line from Lewisberry to York. The company is capitalized at $150,000, and is backed by York county capital.

SCRANTON, PA.—Negotiations are reported to be in progress for the purchase of the Scranton Railway Company and its allied lines by the American Railways Company. E. W. Clark & Company, bankers, control the Scranton Company. It is understood that the deal involves a lease of the Scranton properties by the American Railways Company on a graduated scale of annual interest payments, ending after a term of years at 6 per cent.

BETHLEHEM, PA.—At a general meeting of the stockholders of the several companies interested, it was decided to merge the following roads in this county into one company: Bethlehem & Bath Street Railway Company; Nazareth & Bath Street Railway Company; Bethlehem & Siegfried Street Railway Company; Cement Belt Street Railway Company; Alliance, Bath & Nazareth Street Railway Company; Alliance & Bath Street Railway; Township Line Street Railway Company; Allen Street Railway Company. The main office of the new concern will be located here. The lines concerned in the deal belong to Howard Mutchler, of Easton, and J. S. Moyer, of this place.

FAIRMONT, W. VA.—Directors of the Fairmont & Fairview Traction Company have elected the following named officers: President, E. L. Rutherford, Scottsdale, Pa.; vice-president, S. L. Dillinger, Baltimore, Md.; secretary, Charles E. Conaway, Fairmont, W. Va.; treasurer, B. F. Overholt, Scottsdale; attorney in fact, T. J. Conaway, Fairmont.

STURGEON BAY, WIS.—J. A. Becker, of Milwaukee, has petitioned for a franchise to operate an electric railway in this city.

VANCOUVER, B. C.—The British Columbia Electric Company has completed the plans for a street railway in North Vancouver and work will be commenced as soon as possible. R. H. Sperling is general manager.

TORREON, MEX.—The Torreon Electric Street Railway Company will hold a meeting early in January for the purpose of increasing its capital stock. The company will erect a modern electric power plant. Other important improvements are to be made, including the building of extensions of the lines of the system so as to cover all parts of the city. At a recent meeting of the company Carlos Gonzalez was elected president, and W. B. Mitchell, secretary.

OTTAWA, ONT.—The Ontario Electric Railway Company, which has secured a franchise from Cornwall to Toronto and from Cornwall to Ottawa, has made an official offer to the city of Toronto to bring a radial road into that city on a franchise absolutely terminable in 1921, when the Toronto Railway Company franchise expires. It desires no renewal clause and the city may purchase that part of the road within its limits at the expiration of that franchise.

New Industrial Companies.

THE CHICAGO NUMERICAL TELEPHONE INDEX COMPANY, of Chicago, Ill., has been formed; capital, $2,500. The incorporators are J. W. Arnett, Alfred J. Terry and Earl Harper.

THE TELEGRAPH SIGNAL COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $1,000,000. The incorporators are J. G. Halleran, John McGarvey, Rochester, and M. J. Storer, Morton.

THE MIDDLESEX LIGHT AND EQUIPMENT COMPANY, of New Brunswick, N. J., has been incorporated with a capital stock of $50,000. The incorporators are William Wolfson, Louis Wolfson and William Schlesinger.

THE DIRECT-DRIVE POWER TRANSMISSION COMPANY has incorporated at Los Angeles, Cal., with a capital stock of $500,000. The directors are G. T. Hackley, A. C. Lusby, E. E. Chapman, F. H. Edwards and D. E. Spangler, all of Los Angeles.

THE SYRACUSE ELECTRIC LIGHT EQUIPMENT COMPANY has been incorporated at Syracuse, N. Y., with a capital stock of $100,000. The directors are William Darrone and C. E. Darrone, of Syracuse, and A. A. Buck, of New York.

THE RIVAL GAS & ELECTRICAL FIXTURES SUPPLY COMPANY, of New York City, has been incorporated with a capital stock of $10,000. The directors are G. R. Webster, Brooklyn; Joseph Baumel and Henry Feldman, New York.

THE COLONIAL AUTOMOBILE COMPANY, of St. Louis, Mo., has been granted articles of incorporation. The capital stock is $15,000, all paid. The incorporators are: Frank B. Smiley, Samuel J. Keifer, Henry C. Diebold, C. E. Lane and Lora B. Lane.

THE JERSEY ELECTRIC COMPANY has been formed in Jersey City to take over the business of Roach & Moller, manufacturers of telephones and telephone appliances at 75 to 93 Maple Street, Weehawken. The capital is $250,000. The incorporators are Frank W. Walton, Newark; Frank F. Groff and H. W. Hedenberg, of 141 Broadway, New York.

Legal.

HUDSON RIVER SUBWAY.—Vice-Chancellor Pitney, in Jersey City, has granted a permanent injunction prohibiting the Public Service Corporation from interfering with the Hoboken & Manhattan Railroad Company in building an outlet from its tunnel in Hudson Place, Hoboken. The Public Service Corporation owns the land, but the tunnel has a 999-year lease for railroad purposes.

ROCHESTER TELEPHONE DEAL.—Suit has been begun to compel the promoters of the United States Independent Telephone Company to carry out its option agreements with the stockholders of the Rochester (N. Y.) Telephone Company, which the United States concern was to take over. The action is in the name of Roland A. Chandler against the Alliance Bank, which was used as the depository of stock by the old stockholders. In the test action stock was deposited by F. E. Reed, who owned three shares of the Rochester Telephone Company's stock. The bank gave him a receipt for the stock, which receipt stated that he was to be paid $200 per share under the option agreement. Later on Chandler bought Reed's interest in the stock deposited. He demanded the payment of the $600 due, and payment was refused. His action will test the power of the United States Company to call off the deal in which it secured the options.

Educational.

PURDUE UNIVERSITY MEN known as the Eastern Association of Purdue Alumni celebrated their second annual banquet at the Rensselaer, Troy, on December 2. There was a large gathering of the graduates from Schenectady and the toasts were appropriate.

UNION COLLEGE.—The new electrical laboratory at Union is advancing rapidly. The front portion, seventy-three feet east and west, and twenty-seven feet deep, extends up two stories. The rear portion, thirty-five feet in width and seventy-four feet front to back, is but one story high. The ground floor is divided into three bays called east, west and main laboratories, besides two small bays, one of which will be used as coat room and the other as an entry, toilet and stair room. In the east bay will be the 100,000-volt transformer and other machines for high-potential work. Here also the auxiliary apparatus will be kept. In the west bay will be the receiving and transforming apparatus for power supply to the laboratory and college. The college lighting system will be regulated from that point. This bay will also be used for storing electrochemical apparatus and glass. Both the east and west bays will be lined with shelves to facilitate the storing of all auxiliary apparatus. The main bay will be divided into two laboratories, and in the rear a few small rooms for thesis and graduate work. In the centre of one of these main laboratories will be a gas engine for driving a direct-current generator, for supplying power to the laboratory, which will be fed from a system of wiring on the ceiling with connections running down to the different apparatus. Most of the apparatus, such as direct-current machines, motors, dynamos, etc., from 60 to 500 volts, two alternators, three rotary converters, and a number of induction motors of different sizes, and the different kinds and types of transformers, etc., will be arranged along the walls. The college has an unusual amount of apparatus for electrical work, no characteristic machine being absent. Several machines need duplicating on account of the increased size of the class in electrical engineering, but in variety, Union has an equipment equal to that of any college in the country. The appropriation of $2,000 for maintenance has hardly been touched this year and this will probably be used to duplicate some of the apparatus and for purchasing small motors to run machines. The entire upper floor, with the exception of a small room set aside for professors, will be used as a drafting room and will be equipped throughout with new drafting tables. This and the main laboratory down stairs will be lighted by skylights as well as by the numerous windows in the side walls.

Personal.

E. R. DAVENPORT.

MR. E. R. DAVENPORT has tendered his resignation as assistant secretary of the Edison Electric Illuminating Company of Brooklyn and the Kings County Electric Light & Power Company, the same to take effect January 1, 1906, in order to assume his new duties as sales manager of the Narragansett Electric Lighting Company, Providence, R. I. Mr. Davenport has been connected with the Brooklyn lighting interests for the past ten years, having served during that time in various capacities, among which might be mentioned, in addition to the one referred to above, his work as private secretary to the late Mr. E. A. Leslie, and more recently to Mr. W. W. Freeman, vice-president of the Edison Electric Illuminating Company of Brooklyn, and the Kings County Electric Light & Power Company. His new duties at Providence will offer an excellent opportunity for Mr. Davenport for the utilization of the experience which he has gained with the Brooklyn company, and his many friends in the electrical profession wish him success in his new field of endeavor. The future of the commercial side of electric light and power is largely in such hands as his.

MR. W. D. GHERKY, the Philadelphia engineer and contractor, has moved his offices to more commodious quarters in the Heed Building, 1211-15 Filbert Street.

MR. L. B. STILLWELL, the consulting electrical engineer, and his associate, Mr. John Van Vleck, announce the removal of their offices this week to 100 Broadway, New York City.

MR. JOSEPH C. BELDEN, president of the Belden Mfg. Company, Chicago, manufacturer of magnet wire, telephone cords, braided sleeving and other electrical specialties, was a visitor to New York last week.

MR. JOHN LUTHER PUTNAM, district superintendent of the Central Union Telephone Company, with headquarters at South Bend, Ind., was married at Milwaukee, Wis., on November 29 to Mrs. Marion Brown Traver, of Providence. They have now returned home to South Bend. Mr. Putnam is well known in telephone circles in New York and New England.

MR. ROBERT T. LOZIER, the well-known and successful electric sales manager, has been appointed district sales manager for the gas machinery department of the Power & Mining Machinery Company, with offices at 52 William Street, New York City. He will represent more particularly the American-Crossley engines, the producers of the same name, and the Loomis-Pettibone gas generators.

MR. W. K. VANDERBILT has confirmed the report that the New York Central had contracted with the Niagara, Lockport & Ontario Power Company for electricity to be used in the electrification of the New York Central lines in Western New York. Mr. Vanderbilt inspected this week the Ontario Power Company's plant on the Canadian side of the river, and left Niagara Falls on Monday following the transmission line of the Niagara, Lockport & Ontario Power Company from that city to Syracuse. The Falls Branch, the Auburn Road, and parts of the West Shore will be electrified.

MR. H. E. ANDREWS.—President Horace E. Andrews, of the Cleveland Electric Railroad Company, who has been closely associated with New York Central interests in the acquisition of electric traction lines, may soon resign his position with the Cleveland company to take active charge of the New York Central's electric lines. Mr. William K. Vanderbilt, Jr., is now in charge of the financial affairs connected with the New York Central's electric lines. He is the treasurer of the subsidiary companies which control the traction properties. He is not in charge of the actual operation of these electric lines, and it is this work that Mr. Andrews is expected to do. The plan is for a continuous electric line from Albany to Buffalo.

MR. E. J. KULAS has been appointed secretary and general manager of the Brilliant Electric Company, of Cleveland, Ohio. He was for some years connected with the Buckeye Electric Company and was later with the Bryan-Marsh Co. for a number of years. In taking the management of the Brilliant Electric Company it is his intention to make a tipless lamp, at the same price as charged for the ordinary tipped lamp and under a special patented method of exhaustion. The tipless lamp has had somewhat of a handicap in the high price paid for it, but Mr. Kulas aims to equalize the conditions. At the same time the Brilliant Company is not limited to the manufacture of tipless lamps, but will make a high grade tipped lamp for regular competition.

MR. C. F. BRUSH has written as follows to the *American Shipbuilder:* "I have yours of the 15th concerning windmill storage battery plants for lightships. I have no doubt the scheme is practicable if well designed, and it may be economical where fuel for motors is scarce or costly. A lightship is well adapted for a windmill plant because being far from wind obstruction, a low tower would suffice; and complicated tail mechanism may be dispensed with, the ship at anchor always heading to the wind. Your idea of using compressed air as a medium of power transmission from the wheel to the dynamo, strikes me as an uneconomical and unnecessary complication. The dynamo may be driven directly from the wheel, regulation of output made necessary by speed variation, being effected electrically."

MR. A. W. LEONARD, manager of the Electric Light and Street Railway companies of Houghton, Mich., will succeed A. M. Robertson as manager of the Minneapolis General Electric Company. This change was forecast in our columns several weeks ago. Mr. Robertson's resignation is announced, and he retires immediately. He has been with the company for many years. Mr. Leonard, who succeeds to the management, has been with Stone & Webster for eleven years, and is a young, vigorous man. The Taylors Falls improvement will greatly enlarge the scope of business of the Minneapolis company and increase the responsibilities of management. Mr. Leonard has been with the Houghton companies for three years, and has established an excellent reputation as a capable and popular manager. Mr. Robertson will engage in business in Minneapolis.

MR. W. S. HALL.—Mr. Warren S. Hall, general manager of the Lehigh Valley Transit Company, formerly of the Public Service Corporation of New Jersey, predicts that soon there will be an increase in trolley fares throughout the United States. He says that it is bound to come, in great metropolitan centres as well as on suburban and long cross-country lines. Mr. Hall bases this conclusion on the increased cost of all materials for electric railways. "Trolley men are aghast at the price of copper. It has gone up to 20 cents a pound, and I would not be surprised if it were soon to cost 25 cents. Fifteen and even ten years ago first-class ties could be bought for 18 cents apiece. Most of the roads built ten to fifteen years ago are being reconstructed, and the price of first-class ties is 60 to 75 cents. Poles for the overhead construction have gone up in the same ratio. Rails which formerly cost $18 to $20 a ton now cost as high as $38 a ton. The prices on engines and boilers have advanced 25 per cent., and fuel is also higher."

MR. COLOMAN DE KANDO, of Budapest, Austria-Hungary, director and electrical engineer of Ganz & Company, is at present visiting this country in the interest of his company. To the recommendations of Mr. de Kando is due the stand taken by the Ganz firm with reference to the proper type of motors for heavy traction, and to him belongs the distinction of having first advocated the adoption of three-phase induction motors on the Valtellina line. It is interesting in this connection to note that Mr. de Kando visited this country eight years ago, and studied the various traction schemes which

were in use and being proposed in America. On his return to his own country, he suggested the advisability of using three-phase motors for heavy electric railway work, and it was largely on account of his report that Ganz & Company undertook the development of polyphase traction. As an inventor and designer, Mr. de Kando has been exceptionally active, numerous patents having been granted to him both in his own country and abroad. Our columns of the present issue contain a description of his latest United States patent, which deals with the multiple cascade operation of polyphase induction motors.

MR. HUGH J. McGOWAN.—Because of the increase of duties that have come with the direction of the traction merger plans of the Philadelphia syndicate which he represents, Hugh J. McGowan, president and general manager of the Indianapolis Traction and Terminal Company, will relinquish the active management of the local street car lines. His successor has been named in Robert I. Todd, of Providence, R. I., now general manager of the Rhode Island Company, which controls nearly all the traction lines of Rhode Island. The change in management of the local company will take place January 1. Since the plans of the Dolan-Morgan-McGowan syndicate for the formation of a great merger of Indiana traction lines have assumed definite shape, Mr. McGowan, who is to be president of the merger company in Indiana, has had more work crowded upon him than he could hope to care for and retain his health. Mr. McGowan, however, will remain in the office of president of the Traction and Terminal Company, though Mr. Todd will take over the active management of the local lines. Mr. Todd is one of the best known traction operating men in the East. He is a graduate of Johns Hopkins University, and has had an experience in traction work that is said to have amply fitted him for the important work he will soon take up in Indianapolis. He was formerly connected with the street railway system of Washington, D. C., in an important office, and was later assistant general manager of the Cincinnati Traction Company, under W. Kesley Schoepf. From Cincinnati he went to Providence for the position he is now about to leave. He is thirty-six years old.

Trade Publications.

MILLING MACHINES.—Catalogue No. 42 of the Newton Machine Tool Works, Philadelphia, Pa., describes horizontal slot milling machines. Numerous views are given of milling machines and slotters arranged both for belt driving and for direct connection to electric motors.

METALLIC CONDUITS.—The Bossert Electric Construction Company, Utica, N. Y., has issued an illustrated catalogue dealing with plugged steel conduit boxes, "Monitor" conduit bushings, "Erickson" conduit insulators, flexible conduit bushings and armored conductor bushings.

INSULATING VARNISHES.—The Macon-Evans Varnish Company has issued catalogue B dealing with insulating varnishes for use by the electrical trade. The descriptive matter covers light colored baking and air drying varnishes as well as a complete line of black materials. Full directions are given for the use of these varnishes. This company has also issued descriptive folders treating of paraffine insulating compound and insulating varnishes especially prepared for street railway repair shops, electric light stations and isolated power plants.

PRINTING-PRESS MOTORS.—The Stanley-G. I. Electric Company, Pittsfield, Mass., has issued bulletin No. 42, describing a line of high-grade motors which have been developed for driving "cylinder" and "job" printing presses, feeders, folders, cutters, auto-plates and various types of casting machines. The printing-press motor outfit consists of a motor mounted on a pedestal, in combination with a reversible idler and a rheostat for controlling the speed of the motor. To the lever of the rheostat is attached a cable, which serves the double purpose of moving the lever over the contact points of the rheostat, and also releasing the catch which holds the lever in contact with the points on the rheostat. This is accomplished by pressing a push button which is electrically connected to the release magnet.

STEAM TURBINE.—The Kerr Turbine Company, Wellsville, N. Y., has issued bulletin No. 1, describing the Kerr steam turbine. This turbine is built on the principle of the Pelton water wheel, and is, therefore, of the nozzle and bucket type. The Pelton or double-cup form of bucket gives a nearly complete reversal of the jet of steam, and the proper velocity of the bucket for complete absorption of the energy of the jet is one-half the velocity of the jet. When steam of high pressure is expanded down to atmosphere or into a vacuum, however, the velocity may be from 3,000 to 4,000 feet per second. One-half this speed is much too high for practice. By compounding or dividing the drop of steam pressure into several steps or stages the steam velocity is lowered enough to secure an efficient turbine. An advantage of the nozzle and bucket type is that by varying the number of stages, the size and number of nozzles and the bucket velocity a wide range of speed and power conditions can be met with a turbine of best efficiency for each case.

HIGH-TENSION INSULATORS.—The Locke Insulator Manufacturing Company, Victor, N. Y., has issued some interesting literature dealing with the guarantees which can be met by well-constructed insulators. Sheet No. of the strength of dielectrics and capacity of insulators. Sheet No. 2 tells of the guarantees which can be met by well-constructed insulators. Sheet No. 3 shows numerous views of the plant of the Locke Insulator Mfg. Company, at Victor, N. Y., and describes the processes involved in the manufacture of high-tension insulators. Porcelain glazes for high-voltage insulators are dealt with at great length in sheet No. 1, while sheet No. 5 illustrates and describes colored glazes for insulators. Experience has shown that the majority of delays on high-potential transmission lines are caused by insulators being broken by bullets. The light slate, blue-gray slate or green slate glazes have been produced with the idea of having the color blend, not only with the poles but with the sky and foliage so as to render the insulators less conspicuous.

STURTEVANT BULLETINS.—The B. F. Sturtevant Company, Boston, Mass., will hereafter issue most of its publications periodically, under the title "Sturtevant Engineering Series." Each individual bulletin will treat of some particular product or its application. The series will also include reprints of pertinent articles or technical papers. All publications will be issued in uniform style and size suitable for binding consecutively or in allied groups. By this means the Sturtevant literature will be kept up to date and immediate presentation will be made of new designs or typical applications in a form which will be of the greatest service. Bulletin No. 125, the first of this series, has just been published. It describes in detail the line of automatic vertical engines manufactured by the B. F. Sturtevant Company. These range from 5 x 5-in. to 12 x 10-in., are entirely enclosed and all bearings are provided with positive forced lubrication under 15 pounds pressure. This method has proved greatly superior to older splashing devices, and is not to be confounded with oil pumping systems in which the oil is only lifted into a reservoir from which it merely flows to the bearings. Those engines primarily designed to meet the exacting requirements of dynamo driving, are capable of continuous operation without skilled attention and represent the highest standard of material, workmanship and efficiency.

MOODY'S MAGAZINE.—The first number of this new publication justifies its title, "A monthly review for investors, bankers, and men of affairs." The "Critical Comment" covers a wide range of industrial, financial, economic and political subjects, all treated freely, fairly and fearlessly. These short editorials discuss the bond market, fiduciary institutions in stock speculation, franchises in New York, municipal ownership in Chicago, foreign investments, insurance scandals, conditions of credits, probable future of interest rates, railroad rate legislation, tariff and reciprocity legislation, conditions in Russia and Japan, etc. Amongst the special articles, "The Pitfalls of Speculation," by Mr. Thomas Gibson, is most noteworthy. This analyzes five hundred actual accounts, shows clearly the errors made by ordinary speculators and draws many valuable conclusions. Mr. Charles A. Conant tells where most of the capital for big undertakings comes from. The inquiry department contains many valuable answers to important questions. The correspondence department includes letters from experts in the leading financial and industrial centres. By far the most noteworthy feature of the first number of the magazine, however, and one that distinguishes it and indicates the new field which it occupies, is the symposium on the effects of the rapidly increasing output of gold upon prices, wages, interest, securities, etc. Moody's Magazine is edited by Byron W. Holt and published by The Moody Corporation, at 35 Nassau St., New York City.

News of the Trade.

EDWARDS & CO., electrical manufacturers, of East One Hundred and Forty-fourth Street, New York City, are to put up a new factory 40 x 90, at Exterior Street and Cheever Place.

BRUCE & JOHNSTON, 42 Broadway, New York City, have as publicity managers for the Electrical Show, at Madison Square Garden, done some admirable newspaper work, the quality of their matter and the space secured for it being far beyond the average. It shows a good deal of ability in that direction.

THE WESCO SUPPLY COMPANY, of St. Louis, Mo., announces that it has made arrangements for the southwestern agency for one of the largest and oldest manufacturers of telephone cable, and is prepared to quote the lowest prices on any quality of cable to meet any desired specifications and to make immediate deliveries from a large stock which it will carry at St. Louis.

SAFETY INSULATED WIRE & CABLE COMPANY on December 11 moved its general offices to the large works at West First Street, Bayonne, N. J., where all correspondence should be addressed. This is in line with the centralization of its business, just as the offices of the General Electric Company are maintained at Schenectady. The New York offices of the Safety Company will continue at 114 Liberty Street.

THE WILLIAMS GAUGE COMPANY has recently opened two new offices as follows: At 610 Tremont Building, Boston, which is conducted by Mr. A. S. Uhler; at 810 Continental Trust Building, Denver, Colo., which is in the hands of R. B. Pratt. The Williams Gauge Company has now 14 branch offices located throughout the country, and it will be pleased to receive inquiries for its feed water regulator, steam trap and pump governor, which specialties are used in the largest power plants throughout the country.

THE ELECTRIC COMPANY, with general offices at the Continental Building in Baltimore, desires to be informed of the names and addresses of makers of electric machinery, such as air compressors, motor driven coffee mills and meat grinders, drills, lathes and other machine tools, refrigerating machinery and pumps. The information is desired in connection with the new edition of the Baltimore Electrical Directory published by the Electric Company, which is soon to go to press. Information is requested from those firms who either build and sell appliances provided with the motors, or that are especially arranged for electric drive.

STERLING MOTOR COMPANY.—The Eastern office of the Sterling Electric Motor Company, is now at 143 Liberty Street, New York City. Mr. Allen, formerly consulting electrical engineer of the Marine Engine Company, and Mr. J. J. Estabrook, and others, have formed a company called The Engineering Specialty Company, which will have the handling of the Sterling machines in that territory. Mr. Estabrook was formerly manager of the New York office for Holtzer-Cabot Electric Company. The new firm is well equipped with experience to cover the field for the Sterling line. A complete stock of machinery will be kept at the New York end for immediate delivery in that territory.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 12, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

806,769. ADJUSTABLE SUPPORT FOR TELEGRAPH LINE WIRES; Jasper N. Bell, Stratford, Ia. App. filed Dec. 23, 1904. A split tube is formed of two porcelain semi-cylindrical sections, each of which is curved so as to produce a continuous spiral when the halves are assembled. A tie wire is wound around the groove and serves to hold the halves together.

806,777. CONTROLLING MEANS FOR ELECTRIC MOTORS; Charles M. Clark, South Orange, N. J. App. filed July 7, 1903. Means for controlling motors for a telpherage system in which an operating circuit includes a magnet with a pawl acting on a four-toothed ratchet. Whenever the operating circuit is broken the ratchet is stepped around one notch and reverses the direction of the motors.

806,782. MAGNETIC CLUTCH; George A. Damon, Chicago, Ill. App. filed Feb. 21, 1903. A yielding support for one of the two co-acting members is arranged to permit other than a right-line movement of one of the members in approaching the other.

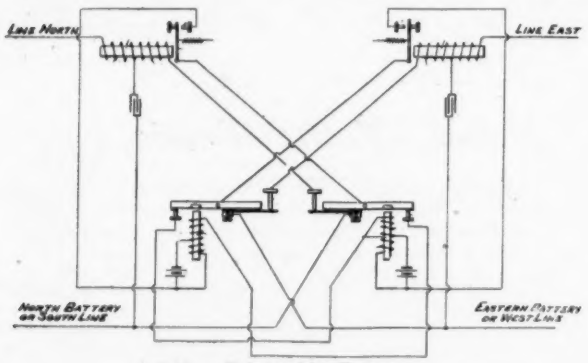
806,789. JOINT FOR ELECTRIC CONDUCTORS; Austin Fleeger, Chicora, Pa. App. filed May 3, 1905. The ends of the two wires to be joined are provided with certain enlarged portions which are placed in a sleeve the extremities of which are then swaged down so as firmly to grip the straight portions of the wires.

806,801. TELEGRAPH REPEATER; Oscar C. Greene, St. Paul, Minn., and Charles H. Gaunt, Topeka, Kan. App. filed Apr. 28, 1902. Has a pair of repeating sounders, the magnet of each sounder having two differential windings, one of which forms a permanently closed and energized local circuit, the other being in a local circuit through the contact points of the adjacent relay, and one of the contact points of the other repeating sounder.

806,812. DOUBLE JACK FOR TELEGRAPH CIRCUITS; Ola Johnson, Conway Springs, Kan. App. filed Mar. 16, 1905. Has for its object to connect either one of two local telegraph sets to the main line by single spring jackets, having plates which are inserted beneath leaf springs upon a base board.

806,835. ELECTROPLATING APPARATUS; Louis Potthoff, Flushing, N. Y. App. filed Dec. 1, 1904.

806,853. MANUFACTURE OF VAPOR ELECTRIC APPARATUS; Percy H. Thomas, East Orange, N. J. App. filed Feb. 12, 1904. Relates to a method of removing the occluded vapors and gases upon the electrode of a mercury vapor lamp. The patentee applies heat in the neighborhood of the mercury lamp and thereby generates an excess of vapor in the container of the apparatus, and by properly regulating the amount of vapor thus produced, causes the current to heat the solid electrode and drive off the occluded gases.



806,884.—Telegraphic Repeater.

806,867. TROLLEY CONTACT; Ira J. Bradshaw, Waukegan, Ill. App. filed Sept. 1, 1905. A rocking frame is pivoted in a housing above the trolley wire so that a ball thereon rolls from one end to the other and makes certain connections when the frame is moved by the impact of the trolley wheel.

806,881. ALTERNATING-CURRENT ELECTRICITY METER; Sebastian Ziana de Ferranti and William Hamilton, Hollinwood, England. App. filed Aug. 14, 1903. (See Current News and Notes.)

806,884. TELEGRAPHIC REPEATER; Stephen D. Field, Stockbridge, Mass. App. filed Dec. 31, 1904. The back stop of the relays is utilized to complete the local circuit. The magnets of the repeating sounders and transmitters are differentially wound and the local circuit traverses one branch of the magnet continuously, the other branch being controlled by the relay contact. The instant that the relay armature begins to leave this back stop, the neutralizing effect is destroyed and the remaining stop, constantly closed in the local magnet comes into play, causing the magnet to attract its armature, and by this arrangement the loss of time due to the excursion of the relay armature is avoided. Sparking is also eliminated to a great extent.

806,887. INSULATOR PIN; Walter T. Goddard, Victor, N. Y. App. filed May 24, 1905. The pin is built up of two main parts, a hollow base and a bolt which passes therethrough. The bolt has an enlarged portion which bears at its inner end upon the end of the base and projects for a considerable distance beyond the base to provide an attaching shank for the insulator.

806,891. TELEGRAPHIC APPARATUS; Melville A. Hawley and William L. Rhoads, St. Louis, Mo. App. filed Apr. 3, 1905. A construction of telegraph repeater in which the relays have a supplemental armature thereon which is attracted by an extra or supplemental magnet. The main portion of the relay armature makes contact for the local circuit of the supplemental magnet which acts as a transmitter.

806,937. INSULATED WIRE SUPPORT; John A. Sullivan, Cleveland, Ohio. App. filed Dec. 15, 1904. The support comprises a pair of semi-cylindrical sections which are arranged to be clamped around two semi-cylindrical porcelain insulators, which are closed upon the wire.

806,950. SELECTIVE SYSTEM FOR PARTY-LINE TELEPHONES; William M. Bruce, Jr., Springfield, Ohio. App. filed April 3, 1905.

806,966. WIRELESS TELEGRAPH SYSTEM; Lee DeForest, New York, N. Y. App. filed Jan. 25, 1904. In order to secure the regularity and persistence of a closed oscillator with the use of an open circuit resonator, the patentee makes use of an antenna having two diverging branches connected to opposite sides of the spark gap and having a wire connection at their upper ends.

807,009. SAFETY APPARATUS FOR RAILWAYS; Samuel L. Adelson, New York, N. Y. App. filed June 29, 1905. Posts are erected adjacent the track corresponding to the various block sections, each having a pair of contact springs. The train has lateral arms contacting therewith for ringing local alarm circuits to indicate the condition of the block.

807,027. STEEL-MIXING PROCESS; Paul Louis Toussaint Heroult, La Praz, France. App. filed Apr. 19, 1905.

807,029. SYSTEM OF ELECTRIC RAILWAYS; Joseph H. Hoadley, New York, N. Y. App. filed Sept. 16, 1904. The air inlet of a gas engine is connected to the trolley pole so that when the pole is lowered, the gas engine may be started to operate a separate generator.

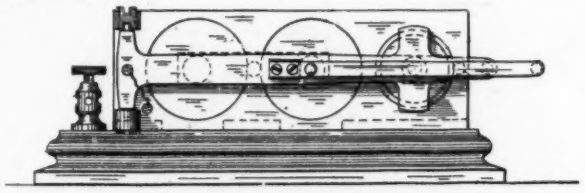
807,034. PROCESS OF DECARBURIZING; Franz von Kugelgen and George O. Seward, Holcombs Rock, Va. App. filed Jan. 16, 1904.

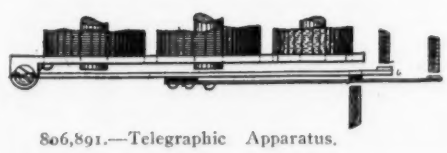
807,051. ELECTRIC ATTACHMENT PLUG; Frederick F. Strong, Boston, Mass. App. filed Apr. 3, 1905. In order to secure the advantages of the Edison threaded shell and avoid the passage of the plurality of turns required, the patentee makes use of a broken or breach plug screw which requires only a quarter of a turn.

807,053. SWITCH SIGNAL; John C. Wigman, Greenbay, Wis. App. filed Apr. 6, 1905. The movements of the switchpoint are transmitted to a circuit closing lever which makes an alarm circuit in case the switch is opened.

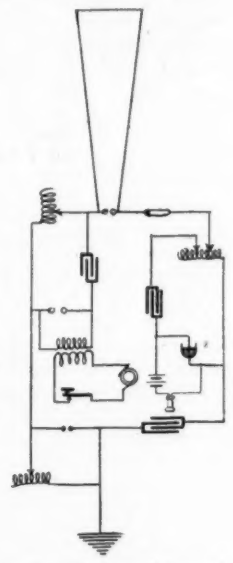
807,093. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed Dec. 11, 1903. The fuse is of the cartridge type, the space around the fuse wire being filled with chalk, plaster-of-paris or soapstone in a granulated form.

807,175. MULTIPLE CASCADE DRIVING SYSTEM OF ROTARY CURRENT MOTORS; Coloman de Kando, Budapest, Austria-Hungary. App. filed Oct. 14, 1903. (See Current News and Notes.)





806,891.—Telegraphic Apparatus.



806,966.—Wireless Telegraph System.

807,199. MAGNET CONTROLLED THIRD RAIL SYSTEM; Henry J. Palmer, Philadelphia, Pa. App. filed Oct. 3, 1904. A plan for railway underground conduit in which an iron cable reposes on a wholly enclosed conductor plate or rail. When the car passes, the iron cable is magnetically drawn up so as to make contact with a sectional rail over which the car is passing.

807,217. RAIL BOND; William G. Stuart, Newburyport, Mass. App. filed July 14, 1904. The bond is laminated and has its ends offset from the plane of the main portion so as to be more conveniently soldered into counter-bored holes in the rail web.

807,235. ALARM AND TELEPHONE SYSTEM; Garrison Babcock, Chicago, Ill. App. filed Dec. 14, 1903.

807,262. JUNCTION BOX; Edwin T. Greenfield, Monticello, N. Y. App. filed Jan. 23, 1904. The box has a series of inleading necks and a series of closing disks therefor cast integral with the walls of the box and in planes parallel therewith, the thickness of the disks being less in each instance than that of the corresponding wall of the box.

807,263. JUNCTION BOX FOR ELECTRICAL CONDUCTORS; Edwin T. Greenfield, Monticello, N. Y. App. filed June 21, 1904. The box is provided with clamping means concentric with the inner surface of the box and additional means for causing the same to act simultaneously upon all of the ends of the inleading conduits.

807,270. THERMAL CUT-OUT FOR ELECTRIC CONDUCTORS; Bryson Dexter Horton, Detroit, Mich. App. filed Mar. 13, 1905. The fuse wire, which is mounted in an enclosing case, is bent at the middle into S-shape. A spring under pressure serves to rupture the fuse when it becomes heated.

807,277. HIGH-VOLTAGE SPARK-ARRESTER; Fritz Jordan, Frankfort-on-the-Main, Germany. App. filed Jan. 6, 1904. Comprises two vertically-disposed bars placed at a distance from each other. One of the bars is of carbon and the other of metal, so that when an arc is struck between the bars, a pearl is formed on the metal bar and a depression is formed on the carbon bar, thereby maintaining the spark-gap constant.

807,307. INSULATOR; Louis McCarthy, Boston, Mass. App. filed Feb. 18, 1904. The insulator comprises a mass of molded insulating composition of bell-shape which surrounds the supply wires of an incandescent lamp and is inserted between the lamp and its supporting bracket.

807,316. TELEPHONIC SYSTEM; Robert H. Polk, Birmingham, Ala. App. filed Jan. 19, 1904.

807,345. FUSIBLE CUT-OUT; George Baehr, McKeesport, Pa. App. filed Jan. 14, 1904. Details.

12,419. ELECTROMECHANICAL DEVICE FOR ELECTRIC TRACTION. Eugenio Cantono, Rome, Italy. App. filed May 10, 1905. A steering appliance for electric motor vehicles in which separate motors are geared to the separate wheels. The motions of the steering head vary resistances in the motor fields so as to accord their speed with the value required.

12,421. APPARATUS FOR PURIFYING, STERILIZING AND AGING LIQUIDS; Robert C. Turner, Columbus, Ohio. App. filed July 28, 1905.